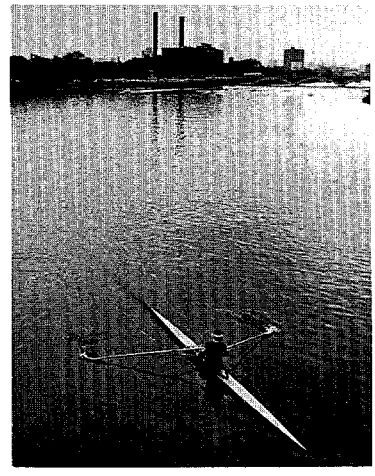
Report of the Southeastern New England Study



a Strategy for Balanced Development and Protection of Water and Related Land Resources in Eastern Massachusetts and Rhode Island

10. PAWCATUCK PLANNING AREA REPORT

New England River Basins Commission

The Southeastern New England Study (SENE) is a "level B water and related land resources study." It was conducted under the provisions of the federal Water Resources Planning Act of 1965. The resources management program the Study produced was developed by a team of federal, state, and regional officials, local citizens, and the scientific community, under the overall coordination of the New England River Basins Commission. It is a part of the Commission's comprehensive, coordinated joint plan for the water and related land resources of New England.

The recommended program for managing the resources of Southeastern New England is described, in increasing level of detail, in the following Final Reports:

A SUMMARY highlighting the principal findings and recommendations of the Study, and their implications for the future of the region.

A REGIONAL REPORT and Environmental Impact Statement describing *in detail* the natural resources, issues and problems facing the region, the alternative solutions examined during the Study, the recommendations made, and their implications. It includes policies and programs for dealing with water supply, land use, water quality, outdoor recreation, marine resources, flood and erosion protection, and key facilities siting, and the changes in state and local government required to implement the program.

Ten PLANNING AREA REPORTS dealing with the same subjects as the Regional Report, but aimed at the local level. Eastern Massachusetts and Rhode Island were divided into ten "planning areas" based either on traditional sub-state divisions or principal river basins. Reports were prepared for the following areas:

1. **Ipswich-North Shore,**
2. **Boston Metropolitan,**
3. **South Shore,**
4. **Cape Cod and the Islands,**
5. **Buzzards Bay,**
6. **Taunton,**
7. **Blackstone and Vicinity,**
8. **Pawtuxet,**
9. **Narragansett Bay and Block Island,**
10. **Pawcatuck**

Other reports prepared during the course of the Study include the following:

Inventory Reports

For each of the ten planning areas, inventory reports were prepared covering the following subjects: climate, meteorology, hydrology, geology; land use, patterns, allocations, and management; special environmental factors; water supply; ground water management; water quality control; outdoor recreation; fish and wildlife; navigation; flood plain zoning and streamflow management; inland wetlands management; coastal resources; irrigation and drainage; sediment and erosion; power; minerals.

Special Reports

In addition to inventory reports, over a dozen special reports were prepared, including: Socio-Economic and Environmental Base Study, Volumes I and II; Economic analyses of water supply and demand issues, power plant siting, coastal resources allocation, and sand and gravel mining; Legal and institutional analyses of the state wetlands laws, arrangements for water supply service, fiscal policy and land control, access to natural resources areas, and management structure for water and land use issues; Urban Waters Special Study; Summaries of public workshops

Copies of reports are available from:

New England River Basins Commission
55 Court Street
Boston, Massachusetts 02108

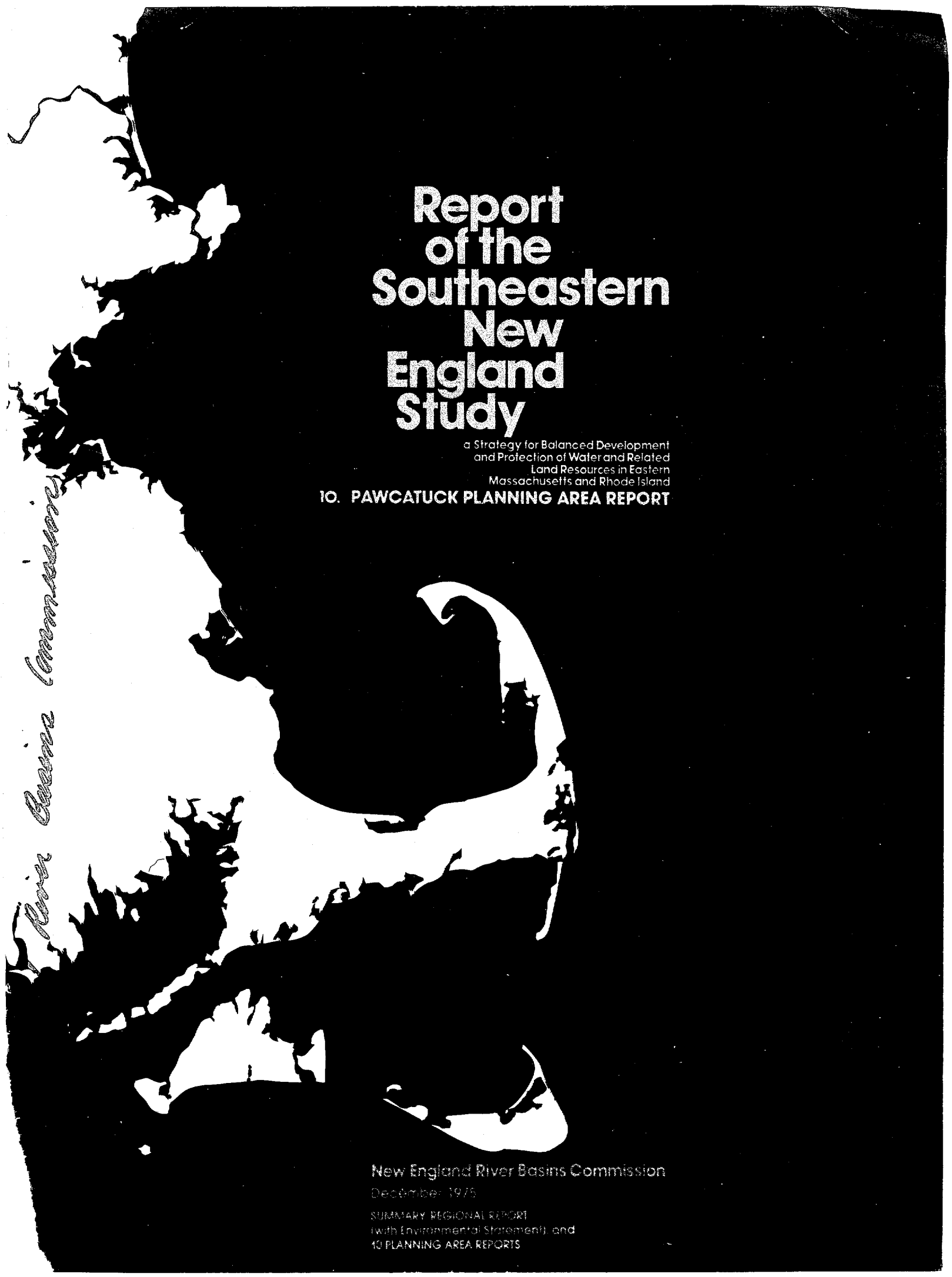
National Technical Information
Service
Springfield, Virginia 22151

and also in each of the 208 libraries and 210 town halls throughout the SENE region.

Report of the Southeastern New England Study

a Strategy for Balanced Development and Protection of Water and Related Land Resources in Eastern Massachusetts and Rhode Island

10. PAWCATUCK PLANNING AREA REPORT



New England River Basins Commission
December 1975

SUMMARY REGIONAL REPORT
(with Environmental Statement), and
10 PLANNING AREA REPORTS

REPORT OF THE SOUTHEASTERN NEW ENGLAND STUDY

READER'S GUIDE: HOW TO REVIEW THIS REPORT

- In five minutes

  FOR A "THUMBNAIL SKETCH"

  Read the **OVERVIEW** which folds out as one large sheet. There is an extra copy in the pocket in the rear for those who would like to mount it on the wall.

- In a half hour or less

  TO LEARN THE MAIN POINTS

  Read the **SUMMARY.** It is published separately. You can read it in either of two ways:

  - **SELECTIVELY.** Read the Chapters on Goals and Approach and Guiding Growth, plus any others that interest you. Chapters are boldly labeled to facilitate selective reading; or

  - **ENTIRELY.** Read the full summary for a fuller understanding of the highlights of the SENE Study.

- In one day or less

  TO UNDERSTAND THE DETAILS

  Read the **REGIONAL REPORT.**

  - **SELECTIVELY.** It is organized exactly like the summary. Wherever your interests lie, you can turn to those sections for additional background, amplifications, analysis of rejected alternatives, and especially for the full text of each recommendation, including who should do what and when. Also, remove the Development Capabilities Maps in the rear pocket and examine the legend to appreciate the type of information the maps portray; or

  - **ENTIRELY.** Read the full report for full appreciation of all recommendations, and how they interrelate.

- In an additional 10 minutes to 2 hours

  FOR APPLICATION TO YOUR AREA

  Get the **PLANNING AREA REPORT** for your locale. Scan it or read it to see how the broader recommendations presented in the Regional Report may apply to the area where you live or work.

TABLE OF CONTENTS

OVERVIEW

Pawcatuck Planning Area

What is the point of the SENE Study Program?

Balanced use and conservation of the region's water and related land resources is the Program's objective. The Southeastern New England (SENE) Water and Related Land Resources Study was authorized and funded by Congress in response to the increasingly troublesome pressures the region's rapid urbanization was exerting on its rich and varied natural resources. The SENE Study has two major goals:

- To recommend actions for all levels of government and private interests to secure for the people of the region the full range of uses and benefits which may be provided by balanced use and protection of the region's water and related lands.

- To assemble information on the resources at a consistent scale and level of detail.

What makes this Study different is that it covers a relatively large geographic area (4400 square miles), it addresses a full range of water and related land uses, and it proposes coordinated actions for all levels of government and private interests.

What does the SENE Study program cover?

The most important recommendations for this planning area include the following:

(1) To accommodate growth in environmentally and economically acceptable ways, municipalities should prohibit or restrict development on Critical Environmental Areas such as wetlands, flood plains, and well sites. Growth should be guided to Developable Areas which cover 40 percent of the planning area. Within this category, municipalities should manage development on resources such as steep slopes, ledge, and soils with septic limitations. Development should be encouraged where services already exist or are planned.

(2) To provide sufficient water supply, the extensive ground water resources should be protected from damaging uses. Existing water supply systems should be consolidated and additional well sites acquired to meet future needs.

(3) To maintain and improve the quality of river and coastal waters, provide secondary levels of treatment at municipal facilities, and carry out current state non-degradation policies.

(4) To meet outdoor recreation needs, adopt scenic rivers legislation to protect the Pawcatuck, Wood, and Beaver Rivers, expand existing facilities throughout the planning area, improve access to recreation areas, and acquire some new areas.

(5) To reduce flood and erosion damages, regulate development or redevelopment in damage-prone areas, and stabilize areas subject to critical erosion by such means as vegetative cover.

(6) To provide vital electrical energy services, consider the possibility of a nuclear power complex at the former Charlestown Naval Air Station, providing that strict environmental measures are met and safety questions resolved.

What will the program do?

If recommended actions are carried out, most 1990 needs for water, sewers, electric power, and outdoor recreation could be met by making more efficient use of facilities, legal authorities, and institutional designs. Protecting Critical Environmental Areas will avoid potential dangers of life and property from flooding, erosion, and contamination of water quality; and will provide productive greenbelts. As a result, new growth in this planning area in the SENE region can be accommodated without harming the high quality environment which attracted the growth in the first place.

You can take the first step in helping to carry out the program by reading the recommendations in the SENE Study Regional and Planning Area Reports. Write your state and Congressional representatives about the Study. Urge your local planning and conservation officials to use the SENE planning process when developing or implementing master plans, zoning ordinances such as flood plain and watershed protection, and other water and land use decisions.

RECOMMENDATIONS

GUIDING GROWTH (Chapter 3)

1. Protect priority Critical Environmental Areas.
2. Restrict development on other Critical Environmental Areas.
3. Manage growth on Developable Areas.
4. Use SENE resource development capability analysis to guide future growth.
5. Accommodate growth where services already exist.

WATER SUPPLY (Chapter 4)

1. Maintain all existing water supplies and protect recharge areas.
2. Consolidate existing water supply systems in planning area municipalities.
3. Acquire additional well sites in planning area municipalities.
4. Obtain additional water supply for Stonington from the Mystic Valley Water Company.
5. Carry out data acquisition on aquifers in Pawcatuck planning area.

WATER QUALITY (Chapter 5)

1. Accelerate municipal wastewater treatment plant construction.
2. Continue the current industrial permits program.
3. Carry out current state non-degradation policies.
4. Provide streambank buffer strips.
5. Provide pump-out facilities and treatment for watercraft wastes.
6. Study and define the landfill leachate problem.

OUTDOOR RECREATION (Chapter 6)

Swimming

1. Continue local management of Quonochontaug Beach and acquire Green Hill Beach.
2. Waive liability for landowners who permit public access for recreation.
3. Secure public access to the coastline.

Boating

4. Continue maintenance of existing channels.
5. Guide development of existing marinas.
6. Provide public boat ramps and fishing piers.

General Outdoor Recreation

7. Develop scenic rivers legislation to protect stretches of the Pawcatuck, Wood, and Beaver Rivers.
8. Increase facilities in four state parks.
9. Acquire ponds along the Connecticut-Rhode Island border.
10. Use SENE Development Capabilities Maps for open space protection.

Wildlife and Fresh Water Fisheries

11. Improve enforcement of wetlands legislation.
12. Acquire most important wildlife habitats.
13. Acquire fishing access to potentially productive ponds.
14. Acquire fishing access to potentially productive streams.

MARINE MANAGEMENT (Chapter 7)

Aquaculture and Shellfish

1. Investigate the potential of tidal ponds for aquaculture.
2. Consider recreational shellfish licensing.
3. Accelerate research on using atomic power plant wastewater for aquaculture.

FLOODING AND EROSION (Chapter 8)

1. Develop flood plain management programs which maximize non-structural solutions.
2. Adopt local flood plain zoning preventing adverse flood plain development.
3. Establish local sediment and erosion control ordinances.
4. Establish forest buffer zones.
5. Establish local forestry programs.
6. Establish local regulations to strengthen flood plain management.
7. Acquire significant flood plains and wetlands.
8. Locate in existing safe buildings in the flood plain.
9. Encourage natural stabilization of coastal erosion areas.

LOCATING KEY FACILITIES (Chapter 9)

1. Continue planning the Charlestown nuclear power complex, applying environmental and safety criteria.

The symbols on this map represent the recommended actions that can be shown on a town-by-town basis. The symbols are placed roughly within each town, and are not intended to be more specifically sited than that.

Legend

- WATER SUPPLY
- WATER QUALITY
- RECREATION
  - Swimming & Public beaches
  - Boating & marinas
  - Fisheries & wildlife
  - Other recreational activities
- MARINE MANAGEMENT
- FLOODING & EROSION CONTROL
- KEY FACILITIES
- NUMERICAL NOTATION
  - 12/4 — Planning Area Report recommendation number
  - Regional Report recommendation number
  - (N signifies no corresponding recommendation)

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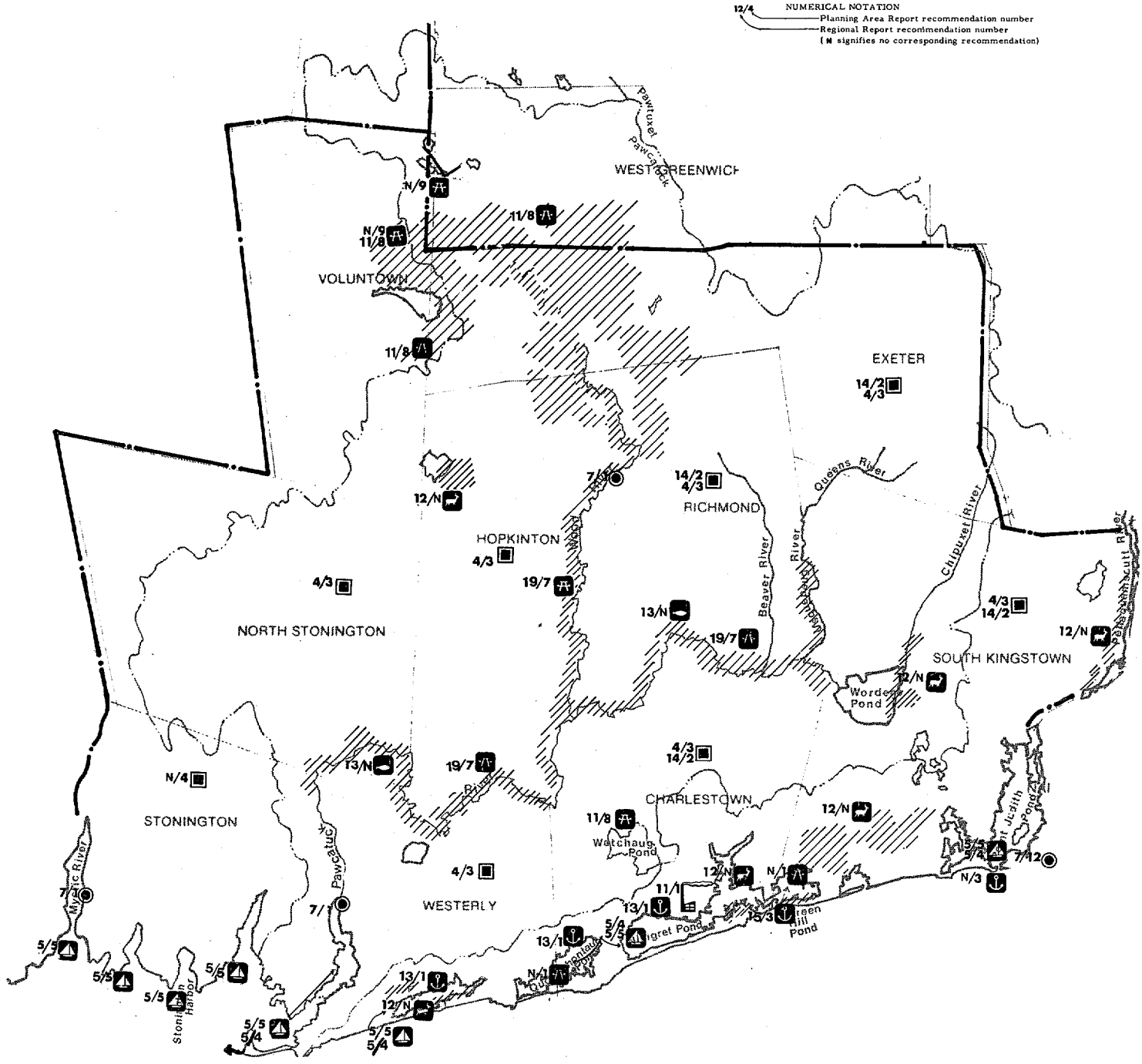


NEW ENGLAND RIVER BASINS COMMISSION
BOSTON, MASSACHUSETTS

SOUTHEASTERN NEW ENGLAND WATER AND RELATED LAND RESOURCES STUDY

Pawcatuck Planning Area
Recommended Actions

CHAPTER 1 THEMES

This report on the Pawcatuck planning area is one component of a comprehensive program for managing water and related land resources on the Southeastern New England (SENE) region. The Study's Regional Report has presented recommended policies and actions from a regionwide or statewide perspective. This Planning Area Report includes applications of those broad-based recommendations to the cities and towns in the Pawcatuck area.

One reason for preparing planning area reports is to connect the actions at the local level with the policy framework and considerations for state and federal levels. This direction was chosen as a response to the region's long history of local autonomy and to the Study's emphasis of placing decision-making at the level commensurate with the anticipated scope of the decision. The planning area boundaries follow the town lines most closely approximating the hydrologic boundaries of river basins.

Three common themes link all the reports:

- **Enhancing the environment enhances the economy.** Preventing degradation of the area's remaining fragile natural resources can both decrease the cost of development to the taxpayer and protect the amenities which are the region's competitive economic advantage.

- **Anticipated growth can be accommodated, but it needs guidance.** There is enough land to accept new growth and still protect Critical Environmental Areas. But that growth should be guided to lands which can support development, and within those lands, to areas already served by essential water, sewer, and transportation services.

- **Existing knowledge, programs, and institutions provide the most realistic tools for achieving results, but some changes are needed.** Full use of ongoing programs, with some changes in how they relate to each other, was viewed as a way of "piggy-backing" on programs which have already weathered most of the realities of the political process. In choosing this strategy, the Study traded off novelty to increase achievability.

Each major chapter in this report contains actions to solve water and related land problems which we face now, or can expect to face in the next 15 years and in some cases into the next century. Table 1.1 sets out the intensity of these problems within each planning area, between them, and for the region as a whole. The relatively undeveloped nature of this planning area, together with relatively slow rates of growth expected leave no serious, or even major resource problems for this planning area relative to the region. Guiding growth, water quality, and flooding and erosion stand out as "moderate problems".

- **Guiding Growth.** Many critical environmental and valuable shoreline resources should be protected, and new growth guided to developable areas.

- **Water Quality.** Presently high quality waters should be maintained and the few areas of lower quality should be upgraded.

- **Flooding and Erosion.** With a long shoreline exposed to severe storms, the area is particularly susceptible to coastal flooding, storm damages, and erosion.

TABLE 1.1 GENERAL INTENSITY OF SENE WATER - RELATED PROBLEMS BY PLANNING AREA

Key
- ● Severe problem
- ○ Major problem
- • Moderate problem
- Blank Minor or no problem

PLANNING AREAS	GUIDING GROWTH (Overall)	Protection of Critical Environmental Areas	Management of Developable Areas	WATER SUPPLY	WATER QUALITY (Overall)	Combined Sewers/Urban-Runoff	Municipal Discharges	Industrial Discharges	Low Streamflow	Land Use Discharges: Septic Systems	Land Use Discharges: Agricultural Runoff	Land Use Discharges: Landfill Leachate	Oil Pollution	Watercraft Wastes	RECREATION (Overall)	Swimming	Boating	Recreational Saltwater Fishing	Camping and Picnicking	Access to Hunting and Fishing Opportunities	Passive Outdoor Recreation	MARINE MANAGEMENT (Overall)	Offshore Fisheries	Shellfish and Aquaculture	Port Development	Offshore Sand and Gravel	Urban Waterfronts	FLOODING AND EROSION (Overall)	Inland Flooding	Coastal Flooding	Inland Erosion	Coastal Erosion	LOCATING KEY FACILITIES (Overall)	Availability of Sand and Gravel	Power Plant Siting	Petroleum Facilities Siting	Solid Waste Management
Ipswich - North Shore	●	○	●	○	○	•	○	•	○	●		○	•	•	•	○	●	•	●	○	○	•	●	○			•	○	•	○	•	○	○	○	●	•	
Boston Metropolitan	●	○	○	●	●	●	●	●	•			○	○	•	●	●	●	○	○	●	●	○			●			○	•		•	○	○				
South Shore	○	•	○	•	○		○	•	○	○	•			•		●	○			○				•					○		•		○	○			
Cape Cod and the Islands	○	●	•	○	•		○			●	•	•		○	•		•		○	•				•					•		•		○				
Buzzards Bay	•	●			○	●	○	○		•	○			•	○		•			•			●	•			•							○			
Taunton	○	●	•	○	●	○	●	●	○	○	○		•		•	●			○	•	•			•			•		•								
Blackstone and Vicinity	●	•		●	●	●	●	●	•	•		○	○		○	○	○		○	●	○	•			○	○	●	●	●	•			•				
Pawtuxet	○	•	•		●		●	●	●	•				•	●		•			○								○	●								
Narragansett Bay	○	●	●	○	○	●	○	•					○	○	•	○	○	○		○	○	○	●	•	●		•	○	○	○	•	○		○	○	●		
Pawcatuck	•	○			•		○	○		○				•			•			•	○			•				•	○		•				●		
REGION AS A WHOLE	●	○	○	●	●	●	●	●	○	○	•	•	•	•	○	○	○		○	○	○	○	○		○	•	•	○	•	○		•	●	○	●	○	○

CHAPTER 2 THE SETTING

The Pawcatuck planning area consists generally of the area which drains into the Pawcatuck River plus the southern coastline of Rhode Island. The area covers some 251,400 land acres, plus another 11,000 acres of water bodies, making a total of some 262,400 acres (about 410 square miles). Six Rhode Island and three Connecticut municipalities are located in this planning area:

RHODE ISLAND		CONNECTICUT
Charlestown	Richmond	North Stonington
Exeter	South Kingstown	Stonington
Hopkinton	Westerly	Voluntown

Forming the largest of Rhode Island's river basins, the Pawcatuck follows a southwest course through the rural Richmond-Charlestown area. Then, turning sharply southward, the river forms the boundary between Westerly, Rhode Island and Stonington, Connecticut, and finally enters Block Island Sound, 33 miles from its source. Major tributaries of the Pawcatuck are the Beaver, Chipuxet, Wood, and Queens Rivers. In all, the 49 principal streams and tributaries of this region have a combined length of 188 miles.

These streams flow through lowlands and gently rolling hills; glacial features such as terraces and kettle holes are abundant. Most of the basin is below 200 feet in elevation, and due to poor drainage, wetland areas are plentiful, sometimes encompassing several square miles. Numerous lakes and ponds are scattered throughout the area; Worden's Pond, the largest of these, covers over 1000 acres. Ground water is plentiful and Pawcatuck aquifers are among the most potentially productive in the SENE region.

Bordered by Block Island Sound, the shoreline of the Pawcatuck planning area is approximately 73 miles long. Major indentations of the coast such as Point Judith Pond, the Pawcatuck River, and Stonington and Mystic Harbors, add miles of shoreline to an otherwise regular coast. Sandy beaches and rocky outcrops are the predominant natural features along the shore, and tidal marshes and mud flats are also present though in lesser abundance. The beaches in this area are important coastal recreation resources, while the numerous tidal ponds, coves, and estuaries provide excellent opportunities for recreational boating.

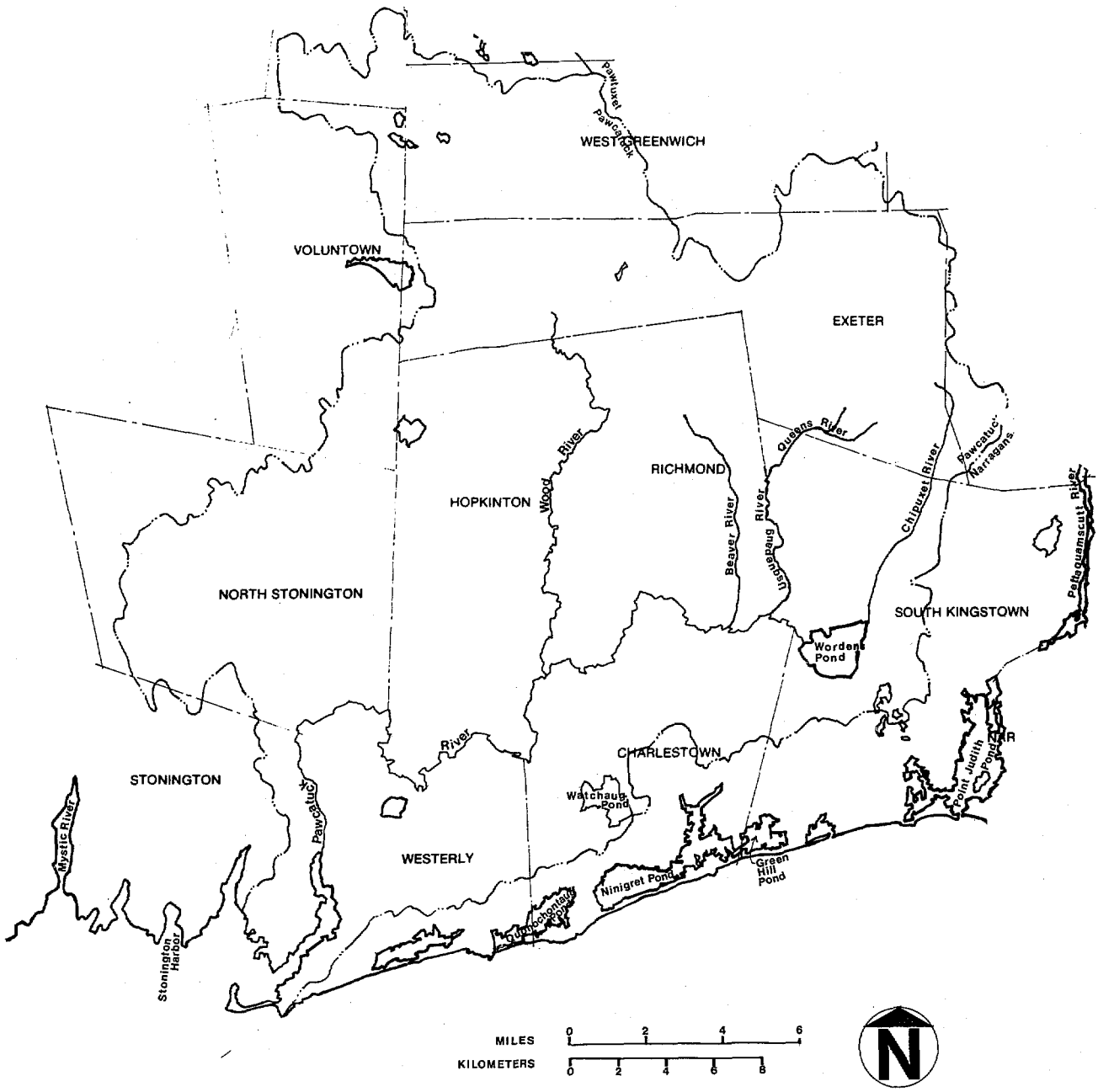
Although the population of this planning area is relatively small – some 70,000 in 1970, a figure between 1 and 2 percent of the region's population – it has grown 30 percent from 54,000 in 1960. This is a growth rate nearly four times that of the SENE region as a whole, and is higher than the other Rhode Island planning areas. Population density went up nearly 25 percent; but the area still has the lowest density of the entire region. The anticipated growth to 88,000 by 1990 and 118,000 by 2020, while still at a higher rate than the region as a whole, is lower than most SENE planning areas, including the Pawtuxet and Narragansett Bay areas. Within the planning area, population has centered in South Kingstown, Stonington, and Westerly where most absolute growth has occurred. But the six other towns, while experiencing smaller absolute increases, had increases of 30 to 55 percent during the 1960-1970 decade.

In 1969 per capita income for the entire Rhode Island coastline was some $3127 (in 1967 dollars) which is about 8 percent less than the national average and over 15 percent less than the average for the SENE region. With a work force of just over 17,000, the area employs 1 percent of the region's work force. Manufacturing is the largest single employer – over one-third of the work force – although the total represents only 1 percent of the region's manufacturing jobs. Other important sectors are government, retail trade and other services (health, business, education, and professional services). Together with manufacturing, these three employment sectors represent 90 percent of the area's employment. During the 1960's slightly over 4000 new jobs were added. The greatest single number -- nearly 1200 – was in the government sector. Most of the other new jobs were in manufacturing, retail and other services.

Early in the Study, participants in a public workshop voiced a preference for protection of ground water supplies, protection of water quality especially along the coast where shellfishing is affected, sensitive expansion and protection of recreation areas together with increased recreation opportunities outside the planning area, and careful definition of wetlands as a way of making enforcement of existing legislation more effective.

Later, during the 90-day review period, over 275 state, regional and municipal officials, federal agencies, and concerned citizens submitted comments on the Study's draft reports. The major comments are summarized in a Regional Report chapter, *"Review of the Report."*

Two major changes were made to *Chapter 6* of the Pawcatuck Planning Area Report. Continuation of local management of Quonochontaug Beach is preferred at this time to state acquisition because the ongoing system is successfully



NEW ENGLAND RIVER BASINS COMMISSION
BOSTON, MASSACHUSETTS

SOUTHEASTERN NEW ENGLAND WATER AND RELATED LAND RESOURCES STUDY

TOWNS AND RIVERS IN THE PLANNING AREA

FIG. NO. 2.1

doing the job of meeting local and non-local recreation needs, while protecting Critical Environmental Areas. Additional marina development has also been given a more cautious go-ahead as the result of municipal officials' and residents' concerns.

Several implications stand out from the preceding profile:

(1) Slow population growth in the future will put relatively little pressure on critical resources, as compared with other planning areas;

(2) Extensive ground water sources may be able to serve other water-short areas of Rhode Island; and

(3) Long beaches and other shoreline resources are subject to wind and wave damages, and need protection from uses which accelerate those damages.

CHAPTER 3 GUIDING GROWTH

Between 1960 and 1970, the face of the Pawcatuck planning area changed as lands in urban uses increased by nearly 50 percent from roughly 14,000 to 21,000 acres. This rate of change coincides with the regional average. But the important difference is that in the Pawcatuck area urban uses account for only 8 percent of the total area, while in the region it is over 20 percent. Over 88 percent of the entire planning area is in forest, open land (such as open wetlands), and agricultural use. Most of this undeveloped land is in forests (including wooded wetlands); practically no forest land has been lost between 1960 and 1970. It was in loss of agricultural lands that most of the increase in urban land can be accounted for. Nearly one-third of the area's agricultural lands was lost between 1960 and 1970.

This shift away from agricultural to urban uses during the sixties was accompanied by a 30 percent increase in population, and an increase in population density of 24 percent from .21 to .26 persons per acre. This means that while the actual number of people and the amount of land that has been developed are the smallest of all the planning areas, the rate of population growth and land consumption for urbanized uses is as high as that of several other Southeastern New England planning areas. The Study's projections indicate a slower population growth of 26 percent between 1970 and 1990, and 69 percent for the entire period from 1970 to 2020. While slower than five other SENE planning areas, including Narragansett Bay and Pawtuxet, these growth rates are still higher than the regional average of 17 percent by 1990 and 45 percent by 2020.

There is an increasing concern among this planning area's residents about finding ways to locate new development where it will lessen the impact on the area's land and water resources. *Chapter 2 of the Regional Report* has shown that enhancing the environment enhances the region's economy. The Study has concluded that if certain planning steps are taken, anticipated growth in the SENE region can be accommodated while protecting the region's fragile resources. This chapter describes the nature of the growth that is expected in the Pawcatuck planning area, and the ability of the resources to accommodate new development. It concludes with strategies recommended to guide growth which are sensitive to both economic and environmental considerations.

The Situation

Anticipated Growth

As previously mentioned, the population of the Pawcatuck planning area is expected to grow by 26 percent to 88,000 in 1990, and a total of 69 percent to 118,000 by 2020. Assuming that the 1960-1970 rate of land consumption will apply to these population increases, nearly 8,000 additional acres will be needed to accommodate the additional population by 1990, and a total of 21,000 additional acres by 2020. These needs are way under the 106,000 acres of developable land in the planning area.

The rates at which the various Pawcatuck area cities and towns will be urbanized will depend to an important extent on relative development pressures. Development pressure represents a classification system using several factors which make a town attractive for growth such as rate of growth of residential, commercial, and other uses, the relative accessibility of the area to employment and population centers in other parts of the region, and the amount of easily developable land. The precise process for grouping the cities and towns by development pressure is described in *Chapter 3 of the Regional Report.* While other more detailed factors which the Study did not include (such as recent building permits) could change the results, the combination of factors the Study did consider does give some useful indication of the pressure for development for Pawcatuck cities and towns relative to all SENE communities (see Table 3.1).

Accommodating Growth

It is expected that almost all of the anticipated growth in the next 20 to 50 years will tend to occur on land not yet developed. As previously mentioned, 8 percent or 21,000

TABLE 3.1 MUNICIPALITY BY DEVELOPMENT PRESSURE: PAWCATUCK PLANNING AREA

High	Medium-High	Medium-Low	Low
South Kingstown	Exeter Hopkinton North Stonington, Conn.	Charlestown Stonington, Conn. Voluntown, Conn. Westerly	Richmond

Note: Communities are grouped into levels of development pressure relative to other communities in the Study region and do not necessarily reflect local building activity.

acres of the planning area's land was in urban uses in 1970. Of that amount 6,000 acres were in medium-intensity residential use of ½ to 1 acre, and another 4,000 acres were in low-intensity use of over 1 acre per unit. This means that 11,000 acres are in high-intensity urban uses such as commercial, residential of multi- and single-family units on less than ½ acre lots, public institutions, industrial, and transportation.

Forested, open, agricultural, and water uses account for the 92 percent of Pawcatuck area not yet developed. In order to assess the implications of growth for these resources, the Study first identified and quantified them. Classified according to development capability, these resources are grouped into three major categories as shown on Table 3.2. Two of these categories represent **Critical Environmental Areas: priority protection (Category A)** and **other protection (Category B)** areas. Category A includes water bodies, wetlands, beaches, and critical coastal erosion areas. Insensitive use of these critical resources might constitute a threat to public health, safety, and welfare. Category B resources include those whose development will result in significant environmental, economic, and social costs. These somewhat less fragile resources are flood plains, prime agricultural soils, unique natural and cultural sites, upland erosion areas, and proposed reservoir sites and related watersheds. **On Developable Areas, Category C, F, and G** resources – recharge areas for high yield aquifers, best upland wildlife habitat, high landscape quality areas, ledge and/or steep slopes, and soils with severe or moderate septic limitations – some development is compatible if it is carefully carried out so as not to damage intrinsic qualities. Existing development (Category E) and publicly owned lands (Category D) have for the most part preempted additional use. But it is worth noting that some developed areas can be used – and further, that use and reuse of such land can be highly efficient.

TABLE 3.2 THE SENE RESOURCE DEVELOPMENT CAPABILITY SYSTEM

CRITICAL ENVIRONMENTAL AREAS REQUIRING PROTECTION

Water Bodies (Category A), blue. [Includes estuaries, shellfish flats, and fish spawning areas.]
Priority Protection Areas (Category A), dark green: wetlands, well sites, beaches, and critical coastal erosion areas.
Other Protection Areas (Category B), light green: flood plains, class I and II agricultural soils, unique natural and cultural sites, [proposed reservoir sites and related watersheds, and upland erosion areas] excluding all "A" areas.

DEVELOPABLE AREAS REQUIRING MANAGEMENT, Excluding All A & B Areas

WATER RESOURCE LIMITATIONS
Aquifers and/or Recharge Areas (Category C_1) black dots: highest yield aquifers in each basin.

WILDLIFE AND SCENIC RESOURCE LIMITATIONS
Wildlife Habitat (Category C_3), black diagonal lines: best upland wildlife habitat other than publicly owned land and [commercial fishing grounds].
Landscape Quality Areas (Category C_2), black vertical lines: land characterized by high landscape quality other than categories C_1 and C_3.

SOILS RESOURCE LIMITATIONS
Ledge and/or Steep Slope (Category C_5), brown: land with slope greater than 15 percent and/or with rock near the surface.
Severe Septic System Limitations (Category C_4), orange: land with severe septic system limitations other than Category C_5.
Moderate to No Septic System Limitations (Categories F and G), yellow: land with moderate or no septic system limitations.

PREEMPTED USE AREAS

Urban Areas (Category E), gray: residential[5/] institutional, commercial and industrial development.
Publicly Owned Lands (Category D), beige: major public parks, forests, watersheds, and military lands.

Notes:

1/ All categories above, except those within brackets, are depicted on the development capabilities maps (plates 1, 2, 3).

2/ Categories in brackets are included to show where they would fit in the overall classification hierarchy, were they included on the plates in the pocket.

3/ All categories above, including those within brackets, are depicted on large-scale, unpublished maps available for inspection as part of the SENE Files.

4/ Categories C_1, C_2 and C_3 overlap with categories C_4, C_5, F, or G. Thus, Category C_3-C_4 is a wildlife habitat located on ledge or steep slopes.

5/ Mapped urban areas (Category E) include all-residential development, although the legend on Plates 1, 2, and 3 reads "residential areas on less than one acre lots."

These water and related land resources of the Pawcatuck planning area have been mapped on Plate 3; the percent of the planning area in each category is displayed on Table 3.3.

As mentioned earlier in this chapter, about 8 percent of the planning area has already been developed (in "urban" use). South Kingstown, Westerly, and Stonington account for most of the existing urbanized land. These urbanized areas embrace an infrastructure including sewer systems which serve just over 20 percent (15,000) of the total planning area population. Another 12 percent of the planning area is publicly owned. Most of the publicly-owned lands are in Voluntown, Exeter, and Charlestown. These combined amounts of urbanized and publicly owned lands which total some 21 percent (54,000 acres) of the planning area, are considerably less than the average for the SENE region (33 percent).

Critical Environmental Areas (Categories A and B – *See Plate 3)* comprise nearly 40 percent of the planning area, higher than the regional average share of 31 percent. The diversity of these resources contributes significantly to the high environmental quality of the Pawcatuck area. **Category A resources, priority protection areas,** occupy about 27 percent of the planning area. Wetlands, for example, are abundant, particularly in South Kingstown, Charlestown, and Westerly. Important examples are the Great Swamp in South Kingstown, Indian Cedar Swamp in Charlestown, and Newton Swamp in Westerly. Many wetlands are prime targets for development. Between 1960 and 1970, over 1,000 acres of the area's open fresh water wetlands were lost and nearly half of the salt water wetlands, especially in North Stonington and Charlestown. *Chapters 6 and 8 of this and the Regional Report* discuss the value of wetlands for flood storage, ground water, plant and wildlife habitat, water quality, and other purposes.

About 12 percent of the planning area is covered by **Category B resources, other protection areas.** The planning area has sizeable amounts of **inland and coastal flood plains** (some 39,000 acres). Development in some of these flood plains has aggravated flooding and storm damage problems *(see Chapter 8, Flooding and Erosion).* **Prime agricultural lands** are few in this planning area, and are also targets for development. The planning area is rich in unique natural and cultural sites, especially South Kingstown and Stonington. *Chapter 3 of the Regional Report discusses the significance of the loss of these areas and methods of protection.*

Developable Areas, Categories C, F, and G *(see Plate 3)* occupy 39 percent of the planning area. Over 10 percent of the developable area has been classified as having **high landscape quality** (defined by diversity and relief). **Development on slopes of over 15 percent** cause risk of erosion and septic system seepage to areas below. Areas which are predominantly **ledge** – either exposed or within three feet of the surface – offer little development potential despite their physical attractiveness and aesthetic quality. Density of development on soils with **severe septic tank limitations** (an estimated 27,000 acres in the area) must be regulated according to availability of sewers.

TABLE 3.3 PERCENT OF LAND AND WATER RESOURCE CATEGORIES IN EACH PLANNING AREA

Planning Area	Total (in 1000's of acres)	Percent (%) of Planning Area				
		Critical Environmental Areas			Developable Areas	Preempted Use Areas
		A	B	A & B	C, F, G	D, E
Ipswich-North Shore	274	19	13	32	34	34
Boston Metropolitan	421	14	9	23	30	47
South Shore	172	17	13	30	43	27
Cape Cod & Islands	378	10	23	33	32	35
Buzzards Bay	205	17	16	33	47	20
Taunton	351	19	22	41	37	22
Blackstone & Vicinity	410	10	11	21	38	41
Pawtuxet	180	11	7	18	41	41
Narragansett Bay	212	16	16	32	34	34
Pawcatuck	262	27	12	39	40	21
SENE	2,865	16%	15%	31%	36%	33%

Sources: See Methodology in the Regional Report.

The Solutions

Recommendations

A number of existing methods are available for protecting the fragile resources listed in Table 3.2, such as existing legislation, local building codes, subdivision regulations, outright purchase. For Priority Protection Areas, within existing channels, the Study recommends:

1. **Protect priority Critical Environmental Areas. Municipalities should prohibit development on Category A Critical Environmental Resources (Priority Protection Areas). The appropriate uses of these resources include: water supply, fisheries production, limited recreation, or as scenic and open space lands.**

Planning and zoning boards should protect **water bodies** from pollution by restricting adjacent development and by controlling urban runoff through subdivision regulations requiring stormwater detention ponds where feasible. Recommendations in *Chapter 5 of this report* will also help to achieve the state's water quality standards. **Estuaries and shellfish flats** should be protected by prohibiting outfalls of effluent and by prohibiting dredging, or near-shore sand and gravel mining. **Wetlands** should be protected through more rigorous enforcement of existing legislation at a local level. *Chapter 8 of the Regional Report* details how the legislation can be improved. *Chapter 6 of the Regional Report* discusses kinds of assistance available to municipalities and they or private interests should acquire the most valuable **wildlife wetlands** and surrounding uplands which are mentioned in *Chapter 6 of this report.* **Critical erosion areas and beaches** should be protected by zoning ordinances prohibiting development. *Chapter 6 of the report* includes recommendations for recreational beach development; *Chapter 8* includes measures in controlling accelerating rates of erosion.

The tools for managing Other Protection Areas (Category B) are often similar to those applicable to A resources.

2. **Restrict development on Other Critical Environmental Areas. Municipalities should restrict development of Category B Critical Environmental resources (Other Protection Areas). Suitable uses to be considered for this category should include agriculture, extensive recreation, forestry, or, in some cases and with proper management, very low density residential use.**

Measures for protecting **flood plains**, described more fully in *Chapter 8 of the Regional Report,* include local flood plain zoning prohibiting development, discouraging or prohibiting reconstruction after substantial storm damages, relocation if floodproofing or structural protection is not available or practical. **Prime agricultural lands** should be protected at the state level by tax incentives, agricultural districts, and acquisition of development rights for the highest priority lands, and at the local level by methods such as transfer of development rights. *(See the Regional Report, Chapter 3,* for further discussion.) **Proposed reservoir sites and unique natural and cultural sites** should be protected by acquisition of fee simple, easements, or development rights. **Upland erosion areas** should be protected by local sediment and erosion control ordinances *(see Chapter 8).*

The nearly 106,000 acres of developable lands (Categories C, F, and G resources) require some management to retain the intrinsic natural functions which these resources perform. The SENE Study recommendation is:

3. **Manage growth on Developable Areas. Municipalities should manage growth on Category C resources and encourage growth on Category F and G resources, especially where infrastructure exists or is planned.**

It is worth noting that this recommendation deals with management of all developable areas, both within existing developed areas, and in areas yet to be developed: there are no developable areas in which management of some kind is not required.

On **ground water recharge areas,** communities should restrict densities so that septic systems will not endanger ground water quality. Densities requiring sewers should be allowed only after analysis of the economic and environmental feasibility of recharge maintenance techniques to prevent depletion of the aquifer. For details about development standards refer to Table 3.4; also *see Chapter 4, Water Supply and Chapter 5, Water Quality.in the Regional Report.* Other ordinances and building codes should control coverage by impermeable surfaces, require stormwater detention basins for recharge of run-off from roofs, streets, parking lots, and driveways. Regulations and sound engineering practices should be used to minimize the effects of activities hazardous to ground water quality such as sanitary landfill, highway deicing salt, industrial waste disposal, agricultural runoff, and sand and gravel mining below the water table. On areas with **high landscape quality, best upland wildlife habitat,** and on unsewered **soils with severe septic system limitation,** only development of very low density should be allowed. Development that would tend to preempt the resource value of wildlife habitat and landscape quality should be carefully evaluated to ensure that adverse impacts are fully taken into account. **Steep slopes** should be protected from erosion by low density use. Development on **moderate limitation areas** should be regulated to correspond

TABLE 3.4 SUGGESTED* GUIDELINES FOR USE OF DEVELOPABLE AREAS SHOWN ON PLATES 1, 2, and 3

MAP PATTERN / MAP COLOR	Other Resource Limitations / Soils Limitations	NONE (color only) No other Resource Limitations	High Landscape Quality (Category C_2)	Upland Wildlife Habitat (Category C_3)	Aquifer and/or Ground water recharge areas (Category C_1)
YELLOW	Moderate to No Limitations for septic system disposal (Category F & G)	- PW & PS . Any I/C . Any Res. - PW only . Med. Intensity I/C . At least 1/2 ac/DU	If clustered on no more than 50% of area - - PW & PS . Any I/C . Any Res. - PW only . Med. Intensity I/C . At least 1/2 ac/DU Unclustered - . Low Intensity I/C . At least 1.0 ac/DU	If clustered on no more than 30% of area - - PW & PS . Any I/C . Any Res. - PW only . Med. Intensity I/C . At least 1/2 ac/DU Unclustered - . Low Intensity I/C . At least 1.5 ac/DU	If clustered on no more than 20% of area - - PW & PS . Any I/C . Any Res. - PW only . Med. Intensity I/C . At Least 1/2 ac/DU Unclustered - . Med. Intensity I/C . At least 1/2 ac/DU Unclustered or no PW & PS - . No I/C . At least 3 ac/DU**
ORANGE	Severe septic system limitations caused by conditions other than slope and ledge soils (Category C_4)	- PW & PS . Any I/C . Any Res. - PW only . Low Intensity I/C . At least 1.5 ac/DU	If clustered on no more than 50% of area - - PW & PS . Any I/C . Any Res. Unclustered or PW only - . Low Intensity I/C . At least 1.5 ac/DU	If clustered on no more than 30% of area - - PW & PS . Any I/C . Any Res. Unclustered or PW only - . Low Intensity I/C . At least 1.5 ac/DU	If clustered on no more than 20% of area - - PW & PS . Any I/C . Any Res. - PS only . Med. Intensity I/C . At least 1/2 ac/DU - PW only . No I/C . At least 3 ac/DU
BROWN	Ledge and/or steep slope greater than 15% (Category C_5)	- PW & PS . No I/C . At least 1/2 ac/DU *** - PW only . No I/C . At least 2 ac/DU	. No I/C . At least 3 ac/DU	. No I/C . At least 3 ac/DU	. No I/C . At least 3 ac/DU

* These are designed to provide a framework for designing guidelines of increasing specificity by state, regional, and local planners, and consultants more intimately knowledgeable with local circumstances.

** In many cases suggested guidelines for development, particularly for ground water, are estimates of probable safe controls made in the absence of greater knowledge of the effects of development on the pollution of aquifers.

*** Erosion control measures should accompany other restrictions on slopes over 15%.

Med. & Low Intensity - refers to water use/effluent discharge/building coverage

Clustering – refers to percent impermeable land surface area which may adversely effect the resource.

PW - Public Water Supply System
PS - Public Sewer System
I/C - Industry/Commercial
Res. - Residential
ac - acre
DU - Dwelling Unit

to the availability of sewers. Higher densities should be encouraged on F and G lands, as many C lands can support only very limited densities.

The SENE Study findings represent a strong beginning for implementing the strategy called for in the three recommendations set out above. While the information on the SENE Development Capabilities Map (plate 3) is too generalized to be useful at the site design level of detail, municipalities can use the resources information to set priorities for action. As an immediate step, municipalities can concentrate on applying SENE Study findings and recommendations into existing ordinances and building codes using more detailed maps and data. This is particularly important for cities and towns subject to high and medium-high development pressure. Further details on suggested methods for resources protection and management are discussed in *Chapter 3 of the Regional Report.*

Although local governments have much of the authority to implement the concept of guiding growth based on resources capability, its implementation will be most effective if adopted as a matter of state policy. Many of the resources extend across town boundaries, and additional funding and information assistance are available at the state level.

The most expeditious way for the states to implement these concepts would be for their interagency policy councils to review and adopt as appropriate the policy issues suggested here. Rhode Island has taken a major step in this direction by preparing a comprehensive land use plan. To further strengthen the plan:

4. **Use SENE resource development capability analysis to guide future growth. The Rhode Island Statewide Planning Program and State Planning Council should incorporate the SENE resource classification system into the land use plan. Guidelines can be developed at state and local levels of government** *(see Chapter 10 of the Regional Report).*

Chapter 3 in the Regional Report describes the economic inefficiencies and environmental detriments of urban sprawl. Making better use of roads, sewer systems, and water supply systems where they already exist could help to avert those costs. Therefore, it is recommended that policies be developed to:

5. **Accommodate growth where services already exist. The Rhode Island Statewide Planning Program, together with state agencies and cities and towns, should implement policies to accommodate further development in already developed areas, and to permit maximum use of existing water, sewer, and transportation services. Planned unit development and the cluster principle should also be encouraged in these areas.**

Establishing a system for determining criteria for locating developments of regional impact is also recommended in the Regional Report. This would be within the framework of the system designed to protect critical areas and manage others, and would enable consideration of environmental and economic implications of siting decisions. Power plant siting problems in this planning area would be under its jurisdiction. Details of this recommendation can be found in the *Locating Key Facilities Chapters of this and the Regional Report, and Chapters 3 and 10 in the Regional Report on Guiding Growth and Strengthening the Management System for Natural Resources.* Consistent with siting criteria suggested for other facilities of regional impact, highway planners and state officials should give special consideration to avoiding Critical Environmental Areas (Categories A and B) and using suitable Developable Areas (C, F, and G) consistent with other needs for the same lands.

Priorities

Municipalities which should act especially promptly to carry out the recommended actions are those with high and medium-high development pressure (Table 3.1): South Kingstown, Exeter, Hopkinton, and North Stonington. Wetlands, prime agricultural lands, and flood plains in these municipalities should be given immediate attention for protection.

Implications

The impact of these recommendations on development patterns in the planning area, considering the amounts and types of land and the projected population, is expected to be important in protecting Critical Environmental Areas while accommodating new growth. The large amount of land available for development compared to that needed (according to recent land consumption rates), gives the planning area considerable opportunity to avoid damages to critical lands. Decision makers should take advantage of these opportunities, first in those portions of the planning area offering existing infrastructure, in order to maximize economic efficiencies and minimize environmental costs. While the SENE Study is not a comprehensive land use plan, the preceding recommendations represent key steps that land use planners can trace to guide the region's future growth.

CHAPTER 4 WATER SUPPLY

The Situation

The Pawcatuck planning area has abundant ground water resources. However, only a fraction of the area's supplies have been tapped. The area's 15 small water supply systems used only 7 million gallons per day (mgd) in 1970. The two largest systems, the Wakefield Water Company and the Westerly Water Department, supply out-of-basin and, in Westerly's case, out-of-state water needs.

Facing only moderate development pressures and low estimated future demands, it is clear that the planning area will be able to supply its own mid- to long-term water needs. To achieve that end, however, it is equally clear that the municipalities will have to establish strict land use regulations, and in some cases purchase and manage existing privately owned water supply systems to provide better intertown coordination and planning.

The Solutions

Planning Area Resources and Opportunities

Only 60 percent of the planning area's population is served by municipal water supply systems. The balance rely on individual domestic wells. The two largest water supply systems in the area are the Westerly Water Department in Westerly, R. I. and Stonington, Connecticut, and the Wakefield Water Company in South Kingstown, R. I. The estimated 1990 maximum day demand

TABLE 4.1 SUMMARY OF 1990 WATER SUPPLY: PAWCATUCK PLANNING AREA

Municipality	Existing System (1970) Source	Safe Yield[a] mgd	1990 Average Demand mgd	1990 Design Demand[b] mgd	Proposed Additional Source of Supply
RHODE ISLAND					
Charlestown	Wells	0.22	.09	.24	Ground water[c]
Exeter	Wells	1.30	.17	.43	Ground water[c]
Hopkinton	Private Wells	---	.11	.29	Ground water
Richmond	Wells	0.18	.05	.13	Ground water[c]
S. Kingstown	Wells	8.97	2.84	5.51	Ground water[d]
Westerly	Wells	9.10	2.69	5.25	Ground water[e]
CONNECTICUT					
Stonington	Westerly	6.00			Westerly Water Department and Mystic Valley Water Company
	Reservoir & Wells	2.00			
	Wells	0.03			
		8.03	2.04	4.12	
N. Stonington	Wells	0.35	.28	.68	Ground water
Voluntown	Private Wells	--	Not expected to have enough demand to require a public water supply system. 1990 supply by individual wells.		

[a] Ground water yield is reported as pumping capacity of system.

[b] Systems relying on ground water must supply maximum day demands.

[c] Although present pumping capacities of the systems in Charlestown, Exeter, and Richmond are equal to or greater than projected 1990 maximum day demands, additional ground water might have to be developed due to expected population growth in areas distant from those now served.

[d] South Kingstown has five different systems serving the town with a combined pumping capacity of 8.97 mgd, an amount greater than the municipality's 1990 demand. However, individual systems might have future demands exceeding their present pumping capacity.

[e] Extremely high seasonal demands on the Westerly system may require development of additional water sources, in spite of projected excess pumping capacity.

for water supply in the basin is approximately 17 mgd. Although the existing capacity available to the basin is 28 mgd, further development and protection of aquifers will be required to meet future needs of individual communities.

Ground water is the most economical alternative for water supply if adequate resources are available and a municipality is willing to make the necessary sacrifices in land use development required to preserve its resources. Ground water is also an economical source of supply for regional systems because treatment costs are usually lower than treatment of surface water sources, and development may be carried out in stages. Because ground water is so abundant in the Pawcatuck planning area, development of surface water sources should not be necessary for many years. Aquifers should be managed by the municipalities in which they occur to prevent degradation and to minimize costs of development and use. Serious depletion of streamflow by overwithdrawal of ground water must be avoided and treatment for removal of manganese must also be anticipated in some cases. Further discussion of these last two issues may be found in a following section of this chapter.

Table 4.1 is a summary of the recommended water supply proposal for the Pawcatuck planning area. Shown are existing safe yields, estimated 1990 demands, and proposed sources of supply for all municipalities in the basin.

Exeter and South Kingstown. Both Exeter and South Kingstown rely on ground water for supply. Exeter is predominantly rural and has only one system which services the Ladd School. The remainder of the town is served by individual private wells. A total of five water supply systems operate in South Kingstown, serving 66 percent of the town's population.

Major ground water aquifers have been mapped upstream from Kenyon in the Usquepaug and Chipuxet River areas of Exeter and South Kingstown. In addition to supplying these communities, water from one of these aquifers is presently exported to Narragansett in the Narragansett Bay planning area. It is anticipated that the combined demand from these three municipalities may continue to be met from this aquifer even beyond 1990.

Both Exeter and South Kingstown, but particularly South Kingstown, which is under high development pressure, are in need of strong land use management plans. Since their water supplies are recharged directly from precipitation infiltration, the use of lands directly above the aquifers must be regulated.

Small municipal systems established in the coastal area of South Kingstown and Narragansett reflect the inability on the part of the privately owned Wakefield Water Company to meet public demands. Seasonal in nature, the demands from these areas do not hold the promise of immediate financial return to offset the costs of extending service to them. In South Kingstown, for example, the Kingstown Fire District in the north, and the South Kingstown Water Department in the south, are physically separated by the Wakefield Water Company, which serves the central portion of the town. This makes it extremely difficult for the two municipal systems to coordinate their activities. It appears to be in the best interests of the people of South Kingstown and Narragansett for the towns to purchase the privately owned company and consolidate the three systems.

Charlestown, Richmond, and Hopkinton. Charlestown and Richmond both use a combination of individual wells and municipal water systems to meet their needs, while Hopkinton has no public system – the entire town is supplied through individual wells. While an abundance of the ground water in all three municipalities appears assured, development within ground water recharge areas can threaten the quality of that supply.

Charlestown might also have quality problems with water withdrawn in the coastal area of the town, where further population growth is expected to occur. Heavy withdrawal from aquifers in this area may result in encorachment of salt water. Also, in the event that enough water could not be withdrawn, water would have to be imported from the northern part of the town, thereby adding extra costs. For reasons of management efficiency, public control of water service is also recommended for Charlestown and Richmond.

Westerly and the Connecticut Portions of the Planning Area. Approximately 96 percent of Westerly's population is served by the Westerly Water Department which also serves the Pawcatuck Borough of Stonington, Connecticut (approximately 44 percent). This system has two well fields. Due to extremely high seasonal demands on the Westerly system, further ground water sources may have to be developed to fully meet future needs of the areas served at present. Potential sources in the northern part of the town could yield sufficient amounts of water to meet demands beyond the year 1990, if used for Westerly only. Protection and careful management of this additional aquifer, as well as of the aquifer now used, should be exercised in order to prevent contamination normally associated with areas of urban development.

Some 24 percent of Stonington is served by a private system, the Mystic Valley Water Company, which uses a combination of surface and ground sources. This system should expand its present source by developing surface water to meet future demands of the southwestern portion of the town and to serve part of Groton, Connecticut.

The Mystic system has a safe yield of 2 mgd and currently supplies 1.23 mgd to Stonington and Groton. The development of a reservoir on Stony Brook would double the system's yield and, in combination with further ground water development in Stonington, would be sufficient to meet long-term needs of both municipalities. However, the Mystic Valley Water Company's long-range plan currently calls for this purpose to be accomplished by raising the dam of its existing reservoir. Opportunities for developing ground water sources in Stonington west of the Pawcatuck Basin and for joining with other systems to the west are also available.

North Stonington and Voluntown, Connecticut, rely entirely on ground water for supply. Approximately 35 percent of North Stonington is served by the Southeastern Connecticut Water Authority, while most of the remainder of the municipality uses individual wells. Voluntown, on the other hand, relies entirely on individual wells and will probably continue to do so in the future. Both municipalities have favorable opportunities to develop ground water supplies which will be adequate for 1990 needs.

There is also a potential surface water reservoir in North Stonington in the Shunock River basin near Norwich Road. Because individual surface water reservoirs are very expensive alternatives for water supply, it is suggested that the ground water resources in the southern part of the basin be developed instead. The potential reservoir site should, however, be protected for possible future use.

The following recommendations for meeting the water supply needs of the Pawcatuck basin planning area reflect the need for a coordinated approach to water management for the region:

1. **Maintain all existing water supplies and protect recharge areas. All existing water supplies in the planning area should be maintained, and zoning measures should be established in each municipality to prohibit the location of facilities which would be hazardous to water quality in ground water recharge areas.**

2. **Consolidate existing water supply systems in planning area municipalities. The municipalities of Charlestown, Richmond, Exeter, and especially South Kingstown, should either consolidate the existing private water supply systems within their boundaries or establish public water systems in order to coordinate the development of ground water resources with land use development.**

3. **Acquire additional well sites in planning area municipalities. The municipalities of North Stonington, Charlestown, Richmond, Hopkinton, Exeter, South Kingstown, and Westerly should acquire additional well sites within their boundaries for the purpose of meeting future supply needs.**

4. **Obtain additional water supply for Stonington from the Mystic Valley Water Company. Stonington should seek to obtain additional supply from the Mystic Valley Water Company.**

The Regional Water Supply Picture

As discussed in the Narragansett Bay Planning Area Report, the Rhode Island Water Resources Board (WRB) is considering the development of Pawcatuck Basin ground water to supplement the existing surface water resources of four lower Narragansett Bay Communities (Portsmouth, Middleton, Newport, and Jamestown).

The U. S. Geological Survey (USGS) has estimated the maximum potential yields of two major aquifers along the Usquepaug River (17 mgd) and along the Chipuxet River (8.6 mgd) in Exeter and South Kingstown. Moreover, recent reports of the USGS identify additional aquifers along the Beaver, Wood, Ashaway, Shunock, and Pawcatuck Rivers.

Although the Pawcatuck planning area's ground water potential has a theoretical yield of as much as 65 mgd, the need to maintain minimum flows in the area's streams significantly reduces the amount which may be withdrawn for water supply use, especially for export. The USGS, in a report on ground water availability in the Pawcatuck River basin, pointed out that export of ground water from the basin will result in depletion of stream flow downstream from future well fields. Because of this, the report cautions that well fields constructed for the purpose of ground water export will have to be carefully designed, and pumping from them will have to be carefully managed, if undesirable depletion of stream flow during periods of dry weather is to be avoided.

A representative of the USGS in Rhode Island has also cautioned that unacceptably high manganese concentrations may develop in some heavily-pumped wells after they are put into production. This potential problem should be anticipated, and provision should be made for eventual installation of manganese removal equipment. Another problem will be the cost of imported ground water to the receiving municipalities. Construction of a pipeline under

Narragansett Bay to Portsmouth, Middletown, Newport, and Jamestown was estimated to cost $19 million in 1974. Furthermore, unless additional storage facilities are constructed in these communities, the cost of meeting maximum day demands with imported ground water will be very high.

A discussion in the Narragansett Bay Planning Area Report points out that since the closing of a U. S. Navy base on Aquidneck Island in 1973, the population and water demands of Newport, Middletown, and Portsmouth have decreased significantly. In addition, it is the stated policy of the Rhode Island Statewide Planning Program to attempt to restore the economy of Aquidneck Island to its approximate 1970 level by 1990. Together, these facts indicate that the water needs of lower Narragansett Bay municipalities will not return to pre-1973 levels until some time after 1990. If so, existing surface sources should be adequate to meet the area's needs through that date. After 1990, other sources (i.e. the Big River Reservoir) may be available to supply modest future increases in demand.

Presently, the Statewide Planning Program's population and economic development projections appear likely. There is a possibility, however, that the naval base land in Newport and Middletown could be opened to a significant level of industrial development. In order to meet possibly high water demands on relatively short notice, *it is important that options for Aquidneck Island's water supply be kept open.* However, because of the more probable projections of low future water needs on the island, and because of the economic and environmental implications of the WRB proposal, the SENE Study does not recommend exportation of Pawcatuck ground water to the lower Narragansett Bay communities at this time.

Recommendations

For ground water supplies to be used locally by planning area communities, the SENE Study makes the following recommendation:

5. **Carry out data acquisition on aquifers in Pawcatuck planning area. The U. S. Geologic Survey should carry out data acquisition and computer simulation of aquifers in the Pawcatuck planning area as a basis for setting and maintaining streamflow depletion standards by the Water Resources Board. Highest priority should be given to the Usquepaug, Chipuxet, Beaver, and Wood River basins in Exeter, South Kingstown, Richmond, and Hopkinton. Funding for this investigation should be provided by the Water Resources Board, the USGS, and the local municipalities.**

Another alternative for meeting long-range water supply needs which is being considered by Rhode Island is the potential for developing an extensive surface water reservoir on the Wood River in the western sections of Exeter and West Greenwich. The Wood River, with an "A" water quality classification, is already suitable for water supply. The estimated cost of the Wood River Reservoir project, determined in 1969, was $21 million. Current construction costs and interest rates may well have doubled this figure. The development of the Wood River Reservoir will not reduce recharge to aquifers upstream of the confluence of the Wood and Pawcatuck rivers. However, the reservoir would adversely affect recharge from streams to ground water aquifers during dry years in the Wood River basin. Therefore, required daily releases during dry periods would have to be designed to offset such adverse affects downstream. It is the SENE Study's conclusion that existing and potential recreational uses of the proposed reservoir site, as well as the costs involved in construction of the reservoir, are strong arguments for development of the full potential of the planning area's ground water resources to serve local needs. Therefore, development of the Wood River Reservoir is not recommended at this time.

CHAPTER 5 WATER QUALITY

The Situation

The waters throughout the Pawcatuck basin are generally of high quality. Tributaries and headwater streams are generally class A or B, according to Rhode Island and Connecticut standards of water quality. One problem stretch is classified as D, suitable only for industrial processes and fish migration; it consists of approximately six miles on the mainstem Pawcatuck River from Kenyon, Rhode Island to its confluence with Meadow Brook. All All other waters of the basin are Class C or higher, and are suitable at least for fish and wildlife habitat, recreational boating, and industrial water supply. Almost all the lakes and ponds of the basin are classed A or B, reflecting high quality and generally low development.

The major sources of pollution along the river are industrial discharges, municipal treatment discharges, and private sanitary discharges. The most common method of treatment in the basin is by individual subsurface disposal systems, which are practical because of the low population density and soil characteristics in much of the area.

A major industrial discharger to the Pawcatuck River is Kenyon Piece Dye Works. This business has a permit for best practicable treatment, which will result in at least Class C waters below discharge.

The Westerly wastewater treatment facility is the largest pollution source on the Pawcatuck River and the only municipal treatment plant. In 1970, approximately 15,000 of Westerly's population of 17,248 were served by sewers which conveyed sanitary wastes to the town's primary treatment facility, resulting in the discharge of about 1.0 mgd of chlorinated effluent to the tidal portion of the Pawcatuck River.

There are no combined sewers in the planning area. The only potential urban runoff problems are in the municipalities of Westerly and Stonington (in Pawcatuck).

While a basin plan has not as yet been prepared as required by the federal Water Pollution Control Act Amendments of 1972, proposals have been developed by the various town consultants, industries, the R. I. Statewide Planning Program, the R. I. Department of Health, and the Connecticut Department of Environmental Protection.

The Solutions

Recommendations

In summary, the primary need in this basin is the maintenance of the present high quality waters and upgrading those few areas of lower quality. The following actions to restore existing water quality and preserve higher quality waters represent a package of ongoing proposals supplemented by SENE Study recommendations which, if fully implemented, are designed to achieve the stated goals.

Restoration. The upgrading of facilities and sewer expansion, as currently proposed, should help in improving the problem areas. The following actions are reviewed to provide a complete picture of basin solutions.

1. **Accelerate municipal wastewater treatment plant construction. (a) Westerly will expand its existing primary treatment facility and provide secondary treatment through the existing outfall to the Pawcatuck estuary. Barring unforeseen delays, this should be completed by mid-1977. (b) Stonington will construct two secondary treatment facilities. One will serve Stonington Borough and will discharge to Fisher's Island Sound. The other will serve Pawcatuck Borough and will discharge to the Pawcatuck estuary. (c) Hopkinton and Richmond will construct a treatment facility serving the Hope Valley area.**

This last facility would be quite small and receive basically domestic wastes. It appears that land disposal could be a potentially viable method and one which would be more advantageous from both a cost and a water quality standpoint, since it would preclude a discharge to the Wood River and allow a B classification. Construction is not expected to begin until at least 1980.

In addition to the above actions:

- **South Kingstown will connect to the secondary treatment facility to be constructed in Narragansett which will discharge to the lower Narragansett Bay.**

This will eliminate the University of Rhode Island discharge to White Horn Brook and several industrial discharges to the Saugatucket River.

Estimated costs of these projects, including major interceptors and treatment facilities are: Westerly – $7,000,000; Stonington – $6,000,000; South Kingstown – $10,800,000; Hope Valley – costs not available due to preliminary nature of proposal.

In addition, to control industrial discharges, the SENE

Study endorses efforts to:

2. **Continue the current industrial permits program. The U.S. Environmental Protection Agency, the Rhode Island Department of Health, and the Connecticut Department of Environmental Protection should continue their current industrial permits program, which is part of the National Pollutant Discharge Elimination System.**

Potential stormwater runoff problems have been identified in the Pawcatuck-Westerly area. The recommendation in the Regional Report dealing with stormwater and wet-weather stream sampling should be considered as a first step to determine the extent and the severity of the problem.

Preservation. The following actions are designed to preserve the high quality of inland and coastal waters of the planning area. The approach is consistent with that outlined in the *Regional Report.* The basic policy recommends that all federal, state, municipal, and private water quality programs should ensure that water bodies currently of swimmable and fishable quality are kept that way. This means:

3. **Carry out current state non-degradation policies by permitting no new discharges to Class A and B fresh waters and SA and SB salt waters.**

This is essentially the anti-degradation policy of the Rhode Island Department of Health. In Connecticut, new discharges to Class B or SB waters can be allowed only if the water quality standard is not violated. This recommendation has potentially far-reaching effects since much of the planning area, with few exceptions, has high quality water. The effects may not be that far reaching, however, because the Connecticut Plan of Conservation and Development does not propose a significant increase in urban development.

In conjunction with this recommendation:

4. **Provide streambank buffer strips. The Rhode Island Statewide Planning Program and Department of Natural Resources, in conjunction with wetland and flood plain programs, should encourage municipalities to provide attractive streambank buffer strips to preserve vegetation and other natural systems which help keep non-point source pollutants from reaching sensitive water quality areas. Such buffer strips will also reinforce proposals for scenic river status discussed in the *Recreation Chapter of this report, and erosion and sedimentation control discussed in Chapter 8.***

Priority should be given to towns subject to high and medium-high development pressure.

In keeping with the preservation theme, there should be continued and more intensive enforcement of effective criteria and compliance procedures in order to minimize septic tank seepage problems.

Vessel pollution can be a threat to high quality waters, especially where pleasurecraft anchor and drift in and over shellfish and bathing areas. In certain cases, the Coast Guard regulations regarding marine sanitation devices will allow certified discharges. Consistent with no new discharge requirements, appropriate state agencies should:

5. **Provide pump-out facilities and treatment for watercraft wastes. Coastal municipalities should provide pump-out facilities with either adequate treatment or disposal to a municipal system. Some funding for these facilities could be acquired through the Department of Health, with additional federal funds from the Environmental Protection Agency.**

Since two of the three proposed coastal treatment plants are in the Pawcatuck estuary, some type of treatment may be needed at marinas located some distance from them. Some type of septic tank/leaching field arrangement may be suitable. However, careful assessment of treating odor controlling chemicals used in holding tanks should be made, or restriction of their use should be considered before using this approach.

Several landfills in the basin have been identified as having problems which have caused, or could cause, water quality degradation now or in the future. Problems with surface drainage, leachate, and lowest portion of the fill in the water table are experienced by sites in: Richmond, Hopkinton, Stonington, and Westerly. South Kingstown experiences only the first two problems. Therefore, the SENE Study recommends:

6. **Study and define the landfill leachate problem. The Rhode Island Department of Health, in consultation with the Solid Waste Management Corporation, should make further field investigations and studies to better define the extent and nature of water quality problems associated with existing and abandoned solid waste disposal sites, with a view to developing adequate perspectives and regional controls.**

CHAPTER 6 OUTDOOR RECREATION

Dense forests, open marshes, unspoiled streams, fragile barrier beaches, and quiet farms – these are the crucial resources which give the Pawcatuck planning area its rural character and make it one of the most important in the SENE region for swimming, boating, camping, picnicking, extensive outdoor recreation (nature study, hiking), fresh water fishing, and hunting.

Embracing the southeastern corner of Connecticut and southwestern Rhode Island, the planning area includes more conservation and recreation land than any other planning area in the SENE region, almost 17 percent of the land area (44,000 acres). And of this outdoor recreation land, almost 90 percent is state owned (38,500 acres).

Besides the planning area's abundant inland recreational opportunities, there are miles of long barrier beaches along south coast. In addition, the south coast and Pawcatuck River make up one of the most significant recreational boating areas in the region.

In short, this planning area offers outdoor recreational opportunities whose quality and variety are matched by few areas in Southeastern New England. And, in spite of its very rural – almost wilderness – setting, the Pawcatuck planning area is readily accessible from the Providence and Worcester planning areas.

SWIMMING

The Situation

The shoreline in the Pawcatuck planning area provides the most extensive regional beach resource in the state. Consisting mostly of barrier beaches which stretch nearly 20 miles east from the mouth of the Pawcatuck River to the town of Narragansett, the coast also includes limited stretches of boulder-strewn shorefront and occasional low bedrock outcrops. Behind the beaches lie broad salt ponds and tidal marshes connected to the open water by a series of breachways which have been dredged and stabilized with jetties for small boat channels.

Depending on ownership and access, the beaches receive varying degrees of use, though never near capacity. During the summer bathing season, which extends from about June 1 through Labor Day, the most popular beaches are seldom overcrowded, even on the hottest days. Although these beaches are quite distant from major population centers, a 1973 report points out that as many as 33 percent of the beach users drive down from Providence or northern Rhode Island and nearly 20 percent come from out-of-state, together representing more than half the people using the beaches. However, there are few available facilities such as entrance roads, parking areas, and rest rooms which would enable more people to use these beaches.

There are about 18 miles (87 acres) of coastal beach, of which 14 miles (42 acres) are publicly accessible. While the existing beach area would be adequate to satisfy future demands, there are problems with coastal erosion and inadequate parking and other facilities connected with beaches.

The Solutions

Alternatives for satisfying swimming needs include acquiring new beaches, enlarging existing beaches, protecting existing beaches, and improving access to existing beaches. Since there is a sizable amount of publicly accessible beach in the planning area, recommendations center on the two latter alternatives.

Recommendations

Rhode Island's fragile barrier beaches should be protected through a balanced state management program, as proposed in University of Rhode Island's Coastal Resources Center Barrier Beach Report, Volumes I and II. Such a program should include acquisition of beaches most valuable for recreation, protection of other areas through flood hazard zoning restrictions, and restrictions on rebuilding areas destroyed by flooding through acquisition or an insurance program (*see also Chapter 8, Flooding and Erosion*).

The program should be jointly implemented by the municipalities and the Coastal Resources Management Council, which should provide technical assistance to the communities so that its regulations would be strictly enforced. Existing regulations should be strictly enforced. It is likely that public purchase of some barrier beach areas will be required to compensate severely restricted landowners, to protect especially fragile areas, and/or to provide for public use. Particularly crucial areas are the Quonochontaug Beach area in Westerly and Charlestown, and the Green Hill Beach in South Kingstown. Management of Quonochontaug is exemplary. It is owned by the Weekapaug Fire District, Shelter Harbor Fire District, and Nope's Island Association which have instituted a program of preserving and maintaining the fragile barrier beach, in-

cluding daily patrols, leaflets with rules of behavior, and public access within the physical limitations of the property.

1. **Continue local management of Quonochontaug Beach and acquire Green Hill Beach. The landowners of Quonochontaug Beach should continue ongoing programs to protect and manage this fragile strand of land for public use.**

   The state should purchase Green Hill Beach and institute a similar program. Restrictions should also be placed on rebuilding development destroyed due to flooding. Cross dune foot traffic should be restricted to stabilized paths and vehicles should be forbidden on the dunes and beach except on existing roads.

Surfcasters, shellfishermen, and swimmers desiring a more remote experience require access to preferably uncrowded conditions. Since by law Rhode Island holds the area between mean high and mean low watermarks in public trust, the only limitation is access. The Rights of Way Commission has determined that there are access points at three mile intervals along some parts of the state's coastline. As recommended in the *Outdoor Recreation chapter of the Regional Report,* the following action should be taken:

2. **Waive liability for landowners who permit public access for recreation. The Rhode Island General Assembly should pass legislation exonerating landowners who permit public access for recreational purposes from liability.**

3. **Secure public access to the coastline. The Rhode Island Department of Natural Resources should examine on an annual basis, markings, conditions, and parking at existing access points along South County Beaches. Publications describing the location and extent of access points should be widely distributed in post offices, sporting stores, and libraries.**

A number of these eroding barrier beaches are serving to meet current needs and can be significant in meeting future swimming needs from other areas in SENE and outside the region as well (such as portions of Connecticut). Therefore, the Regional Report includes recommendations for further beach erosion control studies for Ninigret and East Matunuck Beaches to determine the feasibility and appropriateness of artificial sand nourishment. Napatree Point, owned and managed locally, is one area considered for feasibility study, but not recommended because local sentiment favors natural processes taking their course.

Implications

If implemented, these actions would satisfy demands for bathing beaches, protect fragile barrier beaches, and alleviate traffic congestion presently associated with South County beaches. Contrary to the wishes of year-round residents, the swimming program would not displace tourist business, but for economic reasons accommodate it in an orderly fashion.

RECREATIONAL BOATING

The Situation

The south coast of Rhode Island and the Pawcatuck River, together provide some of the most significant recreation boating centers in the SENE region, accounting for over 10 percent of the fleet based in SENE's tidal waterways. It is estimated (on the basis of 1972 aerial photo boat counts) that about 5,000 boats are either berthed or moored in the planning area's waters.

A great portion of the boating demand is generated by counties adjacent to the Pawcatuck River and the south coast, with nearby areas in Massachusetts and Connecticut responsible for the remaining demand.

The most pressing needs for recreational boating in the Pawcatuck area include additional marina facilities, moorings, public docks, launching ramps, and adjacent parking areas. To provide for any expansion of recreational boating facilities, some dredging, both public and private, will be needed.

On the basis of past navigation studies, the existing marinas tend to meet only 80 to 90 percent of the existing demand for boat slips. These marinas will therefore have to expand, and new marinas will have to be constructed to meet 1990 demands. Land for new marinas will not be widely available after 1990, requiring the provision of more launching ramps to accommodate the large demand for boating facilities.

The current trend toward continuing inflation increases the likelihood that boating will become a more expensive pastime. In addition to higher fuel costs, other expenses likely to increase include purchase, maintenance, and service costs, as well as taxes and insurance rates. As harbors, marinas, and mooring areas become more congested, other recreational alternatives to boating may become more attractive to potential boatowners. Such change would probably diminish the potential rate of boating growth.

Besides these economic factors, the two greatest deterrents to a continuing high rate of boating expansion are strict controls in the disposal of dredged materials and local discouragement of public dredging projects.

Even with decreased demand which will probably result from these trends, about 1800 additional boat spaces will be needed to meet the 1990 demand for the Pawcatuck area. Substantial expansion and additions to existing marinas and yacht clubs still will not be able to absorb the 1990 demand under present conditions. As a result, measures such as channel improvements and boat basins, as well as the use of fore-and-aft-mooring patterns and increased use of dry storage will probably be required.

The Solutions

Recommendations

For existing marinas to be navigable, the channels must be maintained. Therefore:

4. **Continue maintenance of existing channels.** **The Rhode Island Department of Natural Resources and/or the Connecticut Department of Environmental Protection, in cooperation with the Corps of Engineers and towns, should continue to maintain existing channels to serve commercial and recreational navigation at: Mystic River and Harbor, Stonington Harbor, the Pawcatuck River, Little Narragansett Bay, Watch Hill Cove, Winnapaug Pond, Quonochontaug Pond, Ninigret Pond, and Point Judith Pond and Harbor of Refuge.**

According to a 1971 Corps of Engineers aerial survey, there is the potential for the marinas existing in the Pawcatuck Planning Area to accommodate 1990 boating demands without environmental degradation. To achieve this objective,marina operators would have to use existing spaces more efficiently. This action would require guidance and careful coordination.

The SENE Regional Report recommends the formation of a statewide boating advisory committee within the context of the Department of Economic Development's ongoing efforts to promote tourism in Rhode Island. The purpose of the committee would be to plan sound marina development through means ranging from new developments to more efficient use of existing facilities. This committee could devise regulations regarding marina development that minimize disruption of currents, restriction of the tidal prism, excavation in shallow water, and prohibit removal of barrier beaches, filling of wetlands, and filling of shallows beyond the normal high water line and should preserve environmental values. Led by the Department of Economic Development, the committee should include representatives from natural resources and coastal zone planning, but over half the membership should include boaters, salt water fishermen, municipal authorities, and conservationists.

Actions recommended to meet recreational boating demands in the Pawcatuck planning area include the following:

5. **Guide development of existing marinas.** **The proposed state boating advisory committee should control major expansions of marina facilities, mooring and launching ramps at Mystic River and Harbor, Quiambog Cove, Stonington Harbor, Wequetequock Cove, the Pawcatuck River, Little Narragansett Bay, Watch Hill Cove, Colonel Willie Cove, Quonochontaug Pond, Ninigret Pond, and Point Judith Pond and Harbor Refuge. Special consideration should be given to maintaining high water quality where it exists.**

Many of these existing marinas are near shellfish beds so that precautions against contamination and physical destruction must be taken.

Boat ramps are efficient means of accommodating large numbers of recreational boaters. The responsibilities of the Rights of Way Commission and Division of Fish and Wildlife in gaining access and developing boat ramps are described in the Regional Report. In conjunction with recommendations to assure shoreline access, the Study recommends:

6. **Provide public boat ramps and fishing piers.** **The Rhode Island Department of Natural Resources in cooperation with appropriate state and municipal agencies should construct boat ramps and fishing piers or similar facilities such as breakwaters, docks, and coastal bridges which provide walkways for surfcasters to productive salt water fishing areas, particularly in Westerly, Charlestown, South Kingstown, and Narragansett. These facilities should be wide enough to provide space for surfcasting and careful consideration should be given to provide adequate parking.**

Implications

By taking the above actions, the recreational boating needs for the Pawcatuck and a portion of the surrounding areas' demands can be met. To guide in allocating the development of potential facilities in the Pawcatuck's coastal towns, the Corps of Engineers has prepared the following table:

TABLE 6.1: POTENTIAL FOR ADDITIONAL BOATING FACILITIES – 1990*

Town	Potential Additional Slips	Potential Additional Moorings
South Kingstown	160	– –
Charlestown	90	– –
Westerly	90	150
Stonington	340	70
Totals	680	220

* These are preliminary estimates and **should not** be construed as justification for marina development or expansion. Further study – either by towns or by the proposed statewide boating advisory committee (see recommendation 5 in *Chapter 6 of the Regional Report)* – is needed to determine capacities for new facilities.

GENERAL OUTDOOR RECREATION

The Situation

The majority of the 44,000 acres of recreation and conservation land in the planning area is made up of the Pachaug State Forest in Voluntown and various Rhode Island management areas. There are approximately 5,700 acres of privately owned recreation lands (camps, clubs, and campgrounds) and only 100 acres of locally owned conservation and recreation lands. According to the Bureau of Outdoor Recreation, these resources will more than satisfy the 1990 demands of planning area residents for hiking, nature study, and photography, and a large portion of their demands for camping.

Another pressure on recreational resources in the Pawcatuck planning area is a proposed water supply reservoir for the Providence Metropolitan area. The Wood River Reservoir could take 40 percent – some 3000 acres – of Arcadia State Management Area. Plans should be made to compensate for this taking should it occur, to meet demands of tourists and urban dwellers for camping, picnicking, and extensive outdoor recreation. However, development of the Wood River Reservoir is not recommended by the SENE Study *(see Chapter 4 of this report).*

The Solutions

In Chapter 6, Outdoor Recreation in the Regional Report three options for satisfying swimming needs, two options for satisfying camping and picnicking needs, and six options for satisfying extensive outdoor recreation needs are described. The Regional Report also describes economic, environmental, and social implications of each option. The following recommendations for supplying the Pawcatuck's recreational needs have been based on an evaluation of those options and their implications.

Recommendations

Riverine resources in the Pawcatuck planning area present quasi-wilderness recreational opportunities which are unique to SENE. The Fresh Water Wetlands Act restricts the use of the area within 200 feet of, or within 20 feet elevation above, a flowing body of water. DNR is also investigating a scenic rivers system with legislation similar to Massachusetts' which restricts the use of 100 yards of the streambank channel, thereby protecting significantly larger amounts of water related resources. Scenic rivers identified by state legislation are eligible for inclusion in the national Wild and Scenic Rivers System and could qualify for national funds to develop low-intensity recreational facilities such as trails and canoe access points.

7. **Develop scenic rivers legislation to protect stretches of the Pawcatuck, Wood, and Beaver Rivers. Rhode Island Department of Natural Resources should pursue efforts to develop scenic rivers legislation. This state recreational and scenic rivers act could protect the recreational and natural qualities of a 24-mile corridor along the Pawcatuck River, an 11-mile corridor along the Wood River, and a 9-mile corridor along the Beaver River. Furthermore, the R. I. Department of Natural Resources could develop camping and picnicking facilities and canoe access points along the most scenic stretches.**

Camping and picnicking facilities in existing parks and recreation areas can be developed more intensively, a step important for the planning area's tourist economy:

8. **Increase facilities in four state parks. Rhode Island Department of Natural Resources should increase the number of camping and picnicking facilities in Arcadia State Park and Beach Pond State Park and Wachaug Pond in Burlingame. The Connecticut Department of Environmental Protection should consolidate**

Pachaug State Forest and manage portions for hiking and tent camping.

Municipalities object to campground development because of strains on services such as police protection and waste disposal, and because of increased traffic congestion. Problems of private campground developers are further compounded by financial constraints, inadequate training in business management, and seasonal influences on business. To alleviate stresses on both sides, in *Chapter 6 of the Regional Report,* the SENE Study has recommended the formation of a Rhode Island recreational advisory committee, within the Department of Economic Development's (DED) ongoing efforts to promote tourism. Led by the DED, the committee should include the DNR, Statewide Planning Program, municipal representatives, and private recreational interests. The purpose of the committee would be to plan for, encourage, and guide private enterprise. It could develop building and sanitary regulations for implementation at a local level and guarantee loans and identify suitable locations for developers.

The numerous ponds and lakes along the Connecticut-Rhode Island state border are ideal spots for water-enhanced recreation. It is recommended that appropriate authorities:

9. **Acquire ponds along the Connecticut-Rhode Island border. The R. I. Department of Natural Resources and the Conn. Department of Environmental Protection should acquire, or secure access to, some of the ponds along the Connecticut-Rhode Island border: Bailey Pond in Voluntown, Hazard Pond and Wickaboxet Pond in West Greenwich. The proposed recreational advisory committee could guide and encourage environmentally sensitive private campground development.**

Plate 3 shows the location of Critical Environmental Areas, which, as *Chapter 3* explains, have important roles in natural processes such as riverine and coastal flooding and erosion protection, water supply, and wildlife protection. These areas require protection, but can also be used in varying degrees of recreation. Since protection and development of such resources is best coordinated at the local level, it is recommended communities:

10. **Use SENE Development Capabilities Maps for open space protection. Municipalities should plan Critical Environmental Areas identified on SENE's Development Capabilities Maps (Plate 3) for open space protection and greenbelt programs. Methods for protecting such resources without outright acquisition are described in *Chapter 3 of the Regional Report.***

The Trails Advisory Committee (TAC) composed of hikers, snowmobilers, and other private interests, working with recreation and transportation agencies has identified a network of trails in the vicinity of Arcadia. The state should use their recommendations to develop a trail system throughout Rhode Island. BOR has identified one such trail in the Pawcatuck planning area along an abandoned railroad right-of-way. Details about this proposal are in the BOR publication, Recreation Trails: A Guide for Action, available from NERBC. The TAC should evaluate the possible uses and development of this trail and its connections with other possible trails throughout the state.

Chapter 6 of the Regional Report indicated that people in most parts of the U. S. drink water from rivers used for navigation and wastewater disposal, or reservoirs used for timber production or recreation. Reservoirs in Rhode Island, however, are used for a single purpose – the production of drinking water. While there are no state statutes prohibiting low-intensity outdoor recreation on reservoir lands, there is a law holding local water authorities legally responsible for drinking water contamination. For their own protection, trespassing on watershed lands is prohibited. However, evidence in literature suggests that recreational use of reservoirs and related lands can have minimal impact on bacterial and viral counts, certainly within the capacities of best known treatment levels. The Regional Report therefore suggests that the Department of Natural Resources, working with the Department of Health, Water Resources Board, Statewide Planning Program and local authorities, should develop guidelines and regulations for extensive outdoor recreation on water supply watershed lands.

Implications

Along with existing publicly accessible areas, the Bureau of Outdoor Recreation estimates that these actions could help meet nearly half the 1990 demands for picnic areas, all the planning area's demands for extensive outdoor recreation (nature study, photography, hiking), and camping, with over 35,000 additional acres available to meet inland outdoor recreational demands from outside the Pawcatuck planning area. Adequate information is not available to accurately assess the size of those "out of area demands", but the fact that the Blackstone and Vicinity planning area can meet only half its expected 1990 demands gives some indication of the regional demands for the Pawcatuck's resources.

Based on preferences expressed during a Pawcatuck planning area workshop, the SENE Study emphasis on providing more regional recreational opportunities would probably meet with local disapproval. Local citizens at the

meeting voiced complaints that residents from outside of the basin would crowd natural areas and burden municipal services such as fire and police protection. Rather than increasing inland recreation as discussed above, workshop participants favored protection and restoration of critical coastal shoreline areas.

To partially offset these legitimate grievances, it is believed that towns with regional facilities which have user fees should be compensated for the stresses placed upon them. Thus the Study suggests *in the Regional Report, Chapter 6,* that state agencies managing large forests and natural areas charging user fees share revenues with towns to cover increased municipal expenses.

WILDLIFE AND FRESH WATER FISHERIES

The Situation

Most of Pawcatuck planning area is non-urban – over 91 percent of the area is either forest, agricultural, wetlands, or open water. The U. S. Fish and Wildlife Service has estimated that 75 percent of the forest land is rated as fair wildlife habitat, although the state rates this wildlife habitat with higher quality. About 22,400 acres are publicly owned and open to public hunting; another 66,000 are privately owned and open to hunting. This total would meet 1990 in-basin demands for hunting. However, due to the close proximity of the Pawcatuck basin to the Providence metropolitan area, much of the largely unmet hunting demands of that city will be diverted to this planning area.

R. I. Department of Natural Resources has acquired a number of pond access points, but additional points are desirable for meeting future demands. There are currently enough available fresh water fisheries to meet 45 percent of the total 1990 demands, but there are additional opportunities alongside the 75 ponds and 157 miles of streams.

However, in spite of these seemingly abundant resources, it must be emphasized again that the unmet demands of the metropolitan Providence area will continue to spill over into the Pawcatuck planning area. Moreover, about half of the planning area is under moderate to high development pressure, somewhat darkening the future picture for wildlife preservation.

The Solutions

Chapter 6 of the Regional Report describes four options for satisfying the planning area's future demands for wildlife and two options for future meeting demands and their implications. The following recommendations are based on an evaluation of those options.

Recommendations

Due to wetlands multiple benefits of flood damage reduction, water supply, and wildlife production, the Study has recommended protection of them to the maximum extent. This can be done without impairment to economic growth *(see Chapter 3 of the Regional Report).* The Fresh Water, Intertidal, and Salt Water Wetlands Protection Laws give municipalities a substantial amount of authority in deciding whether or not alteration of wetlands should be permitted, but often their efforts are frustrated by inadequate knowledge or expertise. Recommendations for strengthening of the wetlands laws are included in *Chapter 8 of the Regional Report.* Because cumulatively, municipalities can protect significant amounts of wetlands through legislative channels, the Study encourages their responsibilities with this recommendation:

11. Improve enforcement of wetlands legislation.
The R. I. Department of Natural Resources should provide additional technical and legal assistance to local officials to improve enforcement of existing wetlands legislation.

Outright acquisition is the safest assurance that wildlife habitats will be protected, and the state's responsibilities should be to purchase those areas of regional significance, including several thousand acres near the Great Swamp in the vicinity of South Kingstown and Richmond, the area between Truston and Green Hill Pond in Kingston, the upland area southeast of Perryville trout hatchery, near the Rockville Meadows Management Area, and near Winnapoag Pond in Westerly. *(Chapter 6, Regional Report).* However, smaller wetlands, and those adjacent or separate uplands, are often the most productive ones and frequently towns prefer to control them. Hence, the following recommendation.

12. Acquire most important wildlife habitats.
Municipalities and/or private organizations should consider acquiring significant wetlands and upland habitats which are most important for wildlife production and not presently protected by conservation, scenic or agricultural easements (identified in SENE Study single-purpose inventory available at NERBC) throughout the Pawcatuck planning area.

Edges between forest, field, and wetland are often the most productive wildlife habitats. Some of the Study's major policies are the protection of prime agricultural soils, wetlands, and unique natural areas (components of SENE's Critical Environmental Areas). Specific actions for protecting these resources are discussed in *Chapter 3 of this report.*

Fresh water resources abound in the Pawcatuck planning area. To ensure their usefulness to the fisherman, the Study recommends:

13. **Acquire fishing access to potentially productive ponds. The R. I. Division of Fish and Wildlife should acquire public access for fishing to 24 ponds, 20-acres or larger, identified in SENE Study inventories as having good and best fishing potential. This lengthy list can be obtained from the SENE Study single-purpose inventory available at NERBC.**

14. **Acquire fishing access to potentially productive streams. The R. I. Division of Fish and Wildlife should acquire access to 19 streams identified in SENE Study inventories as having good and best fishing potential. This lengthy list can be obtained from the SENE single-purpose inventory.**

In addition the SENE Regional Report has recommended improved fishing access to the Pawcatuck River system, believed to have regional value for meeting fresh water fishing demands.

Implications

Management of Category A and B lands would greatly improve the quality and production of wildlife habitats. If managed and open to hunting, they could support approximately four times the projected 1990 demands. Information was not available to determine the effectiveness of enlarging the boundaries of state hunting areas except for the Great Swamp Management Area which, as mentioned in the *Regional Report*, is of major regional importance.

It should also be noted that private organizations will play increasingly important roles in protecting valuable wildlife habitat for nature study and open space. An option of acquiring public access to all 225,800 acres of wildlife habitat was not recommended, first, becuase of the expense involved, and second, because public preferences expressed at the Pawcatuck public workshop did not support the idea of public access to privately owned land.

The combined recommendations for fresh water fishing would succeed in meeting almost 30 percent of the total 1990 demands. The alternative of creating impoundments was not considered because of the high costs and low return on satisfying total 1990 demands. There is some support in Rhode Island for expanding the licensing requirements to include women and to increase the fees. Revenues gained from an expanded license program are important for expanding state fishery management programs.

CHAPTER 7 MARINE MANAGEMENT

Aside from recreational activities such as boating and swimming, the major marine related issue in the Pawcatuck planning area concerns shellfish and aquaculture. Additional information from a wider perspective can be found in the *SENE Regional Report, Chapter 7, Marine Management.* That chapter covers in specific fashion, sections on offshore fisheries, shellfish and aquaculture, port development, dredged materials disposal, offshore sand and gravel, and urban waterfronts.

Additional marine related topics, such as recreational boating, beach swimming, coastal access, and salt water sportfishing can be found in *Chapter 6 of this and the Regional Report.* Similarly, discussions on power plant siting, including coastal sites, and regional petroleum needs, including coastal implications for tank farms, are to be found in *Chapter 9, Locating Key Facilities in the Regional Report* and in *Chapter 9 of this report.*

AQUACULTURE AND SHELLFISH

The Situation

The south coast of Rhode Island has numerous large tidal salt ponds lying behind protective barrier beaches. These tidal ponds support an extensive recreational shellfishery. However, since no license is required for recreational shellfishermen, there is consequently no reliable estimate of their numbers. Since commercial license data is not collected on a town basis, no projections are available for fishing pressure within specific towns. Statewide, in 1971, there was a total of 3,400 non-resident annual and 14-day vacation licenses sold with a value of $13,500; 40 percent is estimated to have occurred along South County shellfish flats.

Important recreational shellfishing areas include the following: Winnapaug Pond in Westerly; Quonochontaug Pond in Westerly and Charlestown; Ninigret Pond in Charlestown; and Green Hill Pond, Potter Pond, and Point Judith Pond in South Kingstown. Soft-shell clams, oysters, quahogs, and scallops make up the bulk of the shellfishing catch along the South County shoreline.

Although some commercial digging does occur along the south coast, most of the 1000 commercial licenses sold in 1971 (for a value of $13,200) were for use inside Narragansett Bay where the prime commercial shellfish flats exist. However, these commercial diggers cannot adequately supply the commercial trade with supplies of shellfish sufficient to meet all local demands. Of all Rhode Island estuarine habitats, the salt ponds behind the South County beaches probably are most suitable for aquacultural operations *(see SENE Regional Report Chapter 7).* Such operations could supplant the natural shellfish harvest and perhaps, if successful, lead to a new export market.

Careful analysis of potential aquaculture sites would be needed to determine feasibility of those sites for aquacultural operations. Additionally, the state should consider relaxing or revising its general laws to be more amenable to such activities, similar to the more favorable Massachusetts aquacultural statutes.

The Solutions

Based on the previous considerations, the following actions are recommended:

1. **Investigate the potential of tidal ponds for aquaculture. The Division of Fish and Wildlife in conjunction with the Coastal Resources Management Council and the U. R. I. Sea Grant Program, should study the feasibility of utilizing appropriate portions of Winnapaug, Quonochontaug, Ninigret, Green Hill, Potter, or Point Judith ponds for potential aquacultural leasing sites, consistent with SENE Development Capabilities Map (Plate 3) and the criteria mentioned in the Regional Report.**

2. **Consider recreational shellfish licensing. The state of Rhode Island should consider instituting resident and non-resident recreational or noncommercial shellfish licensing by town to be managed by the Division of Fish and Wildlife to pay for a 3 to 4 year field sampling survey which would enable the Division of Fish and Wildlife to prepare a consistent set of technical shellfish management procedures for each coastal town's shellfish program.**

3. **Accelerate research on using atomic power plant wastewater for aquaculture. Consistent with the Regional Report's aquacultural research recommendation, the New England Regional Commission should consider supporting a project at Woods Hole Oceanographic Institute or University of Rhode Island Sea Grant program to accelerate research on the feasibility of using heated cooling water from the proposed Charlestown Nuclear Power Plant to support aquacultural activities in Ninigret Pond, immediately adjacent to the plant site. Special attention should be paid to dangers of contaminants which are harmful to public health.**

CHAPTER 8 FLOODING AND EROSION

Flat terrain, numerous ponds and streams, extensive wetlands and minimum development have combined to limit the extent of inland flooding in the Pawcatuck planning area. The situation is quite different for the coastal areas, however. Tidal flooding has caused damages in all four of the coastal communities in the planning area. Erosion of the coastal beaches and storm damages to dunes and barrier beaches are also significant problems.

In general, the Study's recommendations emphasize that both inland and coastal flood prone areas be protected from development through the application of non-structural flood plain management techniques wherever possible, including maximizing protection of wetlands and applying strict development criteria. Only where there is existing high-value development in small concentrated areas is structural flood protection recommended. Recognition of the multiple values of wetlands – not just as natural flood retention areas, but for wildlife habitat, water supply, recreation, and landscape quality as well – further strengthens the importance of wetlands protection as a uniquely valuable means for reducing flood damages.

The Situation

Inland Flooding and Erosion

Although the Pawcatuck planning area has experienced several above average floods, the damage associated with these floods has been minimal in the non-tidal portion of the basin. The flood of record occurred in March 1968. Other major floods were in February 1886, November 1927, and September 1932. Yet because of the area's natural valley storage areas, flat-gradient streams, and lack of intensive urban development, none of these floods caused extensive damage.

A few potential flood damage areas do exist along the tributaries of the Pawcatuck. The first of these is the village of Ashaway (in Hopkinton) which has been built across the flood plain of the Ashaway River about three-fourths of a mile above the confluence with the Pawcatuck River. A manufacturing company and several residential buildings are subject to flooding in this area. It has been estimated that during the occurrence of a 100-year, 24-hour frequency storm the total damages in the area could amount to about $140,000. A second potential damage area is that of the village of North Stonington, Connecticut, which has been built across the flood plain of the Shunock River. There is a possibility of flood damages occurring to a commercial building and about 10 to 15 residential houses in the area.

Numerous ponds and an extensive network of wetland areas, plus a significant amount of undeveloped forested land, have served to stem high flood flows and keep down flood damages. A total of some 3700 acres of lakes and ponds are scattered throughout the planning area. Nearly one half of the total water surface areas are concentrated in the southerly sections of the basin. The largest is Worden Pond in South Kingstown where the Pawcatuck River originates; the second largest is Watchaug Pond in Charlestown. During flooding periods these ponds and lakes act as retention areas where excess runoff can be stored, thus reducing the amount of flood waters in the rivers and streams in the area.

In addition to these open water bodies, there are numerous wetland areas scattered throughout the basin which provide natural storage areas where excess runoff can be stored rather than entering directly into a river or stream. Inland wetland areas total some 31,250 acres (both open and wooded), about 12 percent of the total land area in the Pawcatuck River basin. The largest individual wetland area in the basin is the Great Swamp which is located within the Great Swamp Wildlife Reservation in South Kingstown. Riverine flood plains, which overlap many of the wetlands acreages cites above, total 28,300 acres for the planning area.

Erosion problems on cropland are expected to be a minor problem in this basin, and the conservation land treatment program is sufficient to handle these problems. Pasture and forest lands have little erosion problems at present. But erosion at areas undergoing development will require proper erosion control measures. Further, the costs of removing sediment from ditches and catch basins and of treating erosion problems once they have developed can be high. Much of the erosion damages can be avoided through a sound urban-environmental forestry program to retain as much of the native vegetation as possible.

Ongoing Programs. The Corps of Engineers is presently conducting a comprehensive flood management study of the Pawcatuck-Narragansett Bay (PNB) area. Authorized following the severe storm of March 1968, the study will include detailed evaluation and recommendations for controlling future flood damages in the Pawcatuck basin. The study will consist of detailed damage surveys to determine the extent and location of the most serious damage under present conditions. These data will be evaluated according to the full range of economic, environmental, and social criteria. During the course of the study, work will be carried out in cooperation with state and local officials.

The U. S. Department of Agriculture, Soil Conservation Service and other cooperating agencies are sponsoring the Rhode Island Resource Conservation and Development (RC&D) Project. This project is locally initiated and directed, and is designed to carry out a program of land conservation and land utilization, accelerated economic development and employment. The project is considering, among other things, barrier beach stabilization for the Rhode Island coast and a shore erosion control study.

Coastal Flooding and Erosion

Intermittent tidal flooding damages have occurred along the Rhode Island coast in the towns of South Kingstown, Charlestown, Westerly, and Stonington (Connecticut). During major coastal storms, high tides of over 15 feet can occur and inundate large areas of low lying land, especially along barrier beach areas.

Hurricanes, though occuring at irregular intervals, are not uncommon to the planning area. Seventy-one hurricanes have occurred since 1635. Of these, 9 were major, causing severe tidal flooding; 25 were somewhat less severe, causing wind and rain damages and moderate tidal flooding. The last two major hurricanes occured in 1938 and 1954. Lesser hurricanes occurred in 1944, 1955, and 1960. The Corps estimates recurring hurricane flood damages (at 1963 prices) for the four coastal municipalities at nearly $14 million for the 1938 hurricane, and $11 million for a recurrence of the 1954 hurricane.

In 1964, the Corps of Engineers published a report on means to prevent loss of lives and property in Rhode Island areas of hurricane tidal flooding. In that report the Division Engineer concluded that no federally-supported improvements for hurricane protection could be justified at that time. Detailed investigations by the Corps along the Connecticut and Rhode Island coast, where heavy concentrations of damages have been experienced, considered a number of protective works: Lords Point in Stonington (not recommended); Stonington Village (not recommended); Pawcatuck in Stonington (completed 1963 at a cost of $945,000); Misquamicut in Westerly (not recommended); and Point Judith project in South Kingstown and Narragansett (deauthorization under consideration). Other areas along the coast were also considered, but in general, the estimated cost of construction exceeded the estimated benefits and precluded federal participation. Reports of the Corps' investigations included methods of tidal flood protection for local consideration which generally included early warning, zoning, beach raising and widening, concrete walls, bulkheads, and rock revetments.

Tidal flood prone areas which include many of these coastal wetlands and barrier beaches total an estimated 10,000 acres for the planning area. The Pawcatuck planning area contains coastal wetlands covering about 1150 acres. The major components of this total occur around Winnapaug Pond in Westerly, around Quonochontaug Pond in Westerly and Charlestown, and around Ninigret Pond in Charlestown. These wetlands together with the extensive barrier beaches provide important buffers to storm damages.

The Corps of Engineers has identified critical coastal erosion of 3 feet or more per year along Napatree Beach in Westerly and the Matunuck Beach area in South Kingstown – a total of 8800 feet per year. Non-critical erosion, continuing at a rate of less than 3 feet per year, occurs along Misquamicut Beach, near Weekapaug, along the Ninigret Conservation area, along the Green Hill Barrier Beach and East Matunuck.

A particularly serious problem in this planning area has been residential development on barrier beaches. Such development is subject to serious coastal flooding as well as causing a loss of barrier beaches which provide a storm buffer for other areas. Despite Coastal Resources Management Council regulations against such development, special exceptions plus the availability of federally-sponsored flood insurance have, in effect, encouraged continuing construction in these high hazard critical areas.

The Solutions

Options considered for reducing future flood damages included flood plain zoning, flood proofing, and flood insurance. These measures, taken together, were expected to keep riverine flooding problems at a minimum and reduce losses due to flood damage. Additional measures considered for reducing coastal damages included a number of structural techniques designed to reduce erosion and property loss. Also considered were expanded and improved storm surge and flood forecasting and warning services. The general implications of these measures are discussed more fully in *Chapter 8 of the Regional Report.*

Recommendations

A major result of the SENE Study has been the classification of the region's resources according to their capability. Inland and coastal wetlands, estuaries, beaches, barrier beaches, and critical coastal erosion areas have been classified as "A" resources, requiring the greatest degree of protection from development. Flood plains and hazardous coastal flooding areas (both to the 100-year flood frequency line) have been classified as "B" resources or management areas which have very limited tolerance for development, but with proper management are suitable for such compatible activities as agriculture or recreation.

In keeping with these resource classifications, it has been recommended that comprehensive flood plain management

programs be developed for flood prone areas, making use of non-structural solutions wherever possible. All such programs should be developed in close cooperation between federal and state agencies, and local governments and interests. They should also be coordinated with related programs, such as the National Flood Insurance Program, flood forecasting service of the National Weather Service, state wetlands acts, state land use planning programs, and, for coastal areas, with state coastal zone management programs.

As discussed in the previous section, two important programs are now ongoing which cover the Pawcatuck planning area. Through the Pawcatuck-Narragansett Bay (PNB) Study, the Corps of Engineers is authorized to investigate means for reducing flood damages. However, the coastal drainage area of the planning area is not included. The Soil Conservation Service and a number of Rhode Island agencies and groups are sponsoring the Rhode Island Resource Conservation & Development project, which, among other things, provides for consideration of flood protection projects.

Section 73 of the Water Resources Development Act of 1974 authorizes federal cost sharing for non-structural measures. Although implementation of Section 73 has presently been deferred by the Office of Management and Budget (OMB). Application of the cost sharing authority can be an important factor in making non-structural solutions more competitive than they have been.

Therefore,

1. **Develop flood plain management programs which maximize non-structural solutions. The Corps of Engineers, Soil Conservation Service, and other sponsoring and participating agencies should, as part of the PNB and RC&D projects, give full consideration to the viability and efficiency of implementing non-structural projects, in light of the potential for federal cost sharing under Section 73 authority.**

A recent source of choices for coastal flood and storm hazard areas is the "Application of Nonstructural Measures to Coastal Flooding," prepared for NERBC by Cheney, Miller, and Ellis, with special focus on the Pawcatuck planning area communities of Westerly, R.I. and Stonington, Connecticut.

Projects considered for coastal municipalities should be closely coordinated with the state's coastal zone management program. Therefore, in coordination with the PNB, RC&D, and state coastal zone management programs, and as a condition for future federal funding.

2. **Adopt local flood plain zoning preventing adverse flood plain development. Municipalities should adopt flood plain zoning to prevent adverse development in flood prone areas (and particularly in the 100-year floodway) as defined under the National Flood Insurance Program.**

This also includes incorporating inland and coastal wetlands, eroding areas, barrier beaches, and storms of record on the map upon which the zoning is based. HUD is considering new ways of delineating coastal storm hazard areas in order to make the mapping process and insurance rates more accurately reflect coastal conditions. All related regulations – building codes, subdivision regulations, sanitary codes – should reinforce this policy of preventing adverse development and redevelopment in the 100-year flood plain. The regulations should also take advantage of the restrictive provisions of state wetlands regulations, scenic rivers programs, barrier beach regulations, and the like. Technical assistance should be provided to all officials responsible for enforcing the zoning and related regulations.

Related to local zoning action are two recommendations for controlling local sedimentation and inland erosion problems.

3. **Establish local sediment and erosion control ordinances. Municipalities, assisted by the U. S. Department of Agriculture and the Department of Natural Resources, should establish local sediment and erosion control ordinances.**

A model for such ordinances is included in the more detailed information prepared for the Study and available at NERBC.

4. **Establish forest buffer zones. Municipalities should establish appropriate forest buffer zones within 200 feet of streams and lakes to preserve vegetation and maintain natural systems through forestry techniques to help keep non-point source pollutants from reaching sensitive water quality areas.**

Towns with existing high and medium-high development pressure – South Kingstown, Exeter, Hopkinton, and North Stonington (Connecticut) – *(see Chapter 3, Guiding Growth)* should be among the first to implement these two recommendations.

In addition to the recommendation above,

5. **Establish local forestry programs. Land owners should control forest road erosion by proper road location and stabilization activities such as seeding and ditching.**

6. **Establish local regulations to strengthen flood plain management. Municipalities should ensure that all regulations, including building and sanitary codes, reinforce the intent of the zoning districts and regulations recommended above.**

In conjunction with a zoning program:

7. **Acquire significant flood plains and wetlands. Municipalities and state agencies should investigate continuing possibilities to acquire those wetlands and flood plain areas most significant for flood damage reduction and protection, and which have water supply, wildlife, and/or recreation values.**

Particular emphasis should be given to protection of areas classified as unique natural areas and those located in areas subject to high and medium development pressure. More specific actions regarding wetlands protection are included in *Chapter 8 of the Regional Report.* Protection of wetlands and flood plains is also expected to help existing structural flood protection projects do their job by keeping flood flows to within the design capacity of the existing dams, channels, etc.

In built-up and heavily used areas such as Westerly and Pawcatuck, alternative locations outside the flood plain may not be feasible or appropriate:

8. **Locate in existing safe buildings in the flood plain. Where location outside the flood plain is not feasible, municipalities should encourage private interests to locate in existing safe buildings in the flood plain rather than permitting new construction in the flood plain.**

Floodproofing, especially of existing buildings, is particularly appropriate where only moderate flooding is expected, where other types of flood protection are not feasible, or where activities on waterfront location need some degree of protection. Improved and expanded storm and flood forecasting and warning services, recommended in *Chapter 8 of the Regional Report,* will also be important in keeping down future damage costs.

The Regional Report, Chapter 8, contains recommendations for including critical coastal erosion areas in 100-year coastal flood prone areas and putting this entire coastal flooding zone under the jurisdiction of the Coastal Resource Management Council.

On a local level, recommendation number 2 called for prohibiting development and other damaging uses of critical erosion areas through local flood plain zoning. In addition, municipalities should:

9. **Encourage natural stabilization of coastal erosion areas. Municipalities and conservation commissions should continue to encourage stabilization of coastal erosion areas and barrier beaches, giving priority to areas experiencing critical rates of erosion (3 feet or more per year).**

Use of vegetative cover, snow fences, discarded Christmas trees, and boardwalks have proven effective approaches to control accelerating rates of wind and wave erosion. Additional guidance for protecting specific areas is contained in the University of Rhode Island, Coastal Resource Center's two-volume Barrier Beach report.

No specific sites have been identified for structural erosion control projects in this planning area. However, *Chapter 8 of the Regional Report* recommends selective construction of erosion control projects for areas other than beaches such as eroding bluffs (except for unique natural sites). Artificial beach nourishment does not provide substantial benefits unless public recreational benefits are added in as well. Therefore, further discussion of the possibilities for beach nourishment are included in *Chapter 6, Outdoor Recreation,* of this report. Any studies and projects should address the littoral drift relationships between beach erosion and headland protection.

Implications

This approach is a good deal more restrictive than the National Flood Insurance Program requires. But it does make full recognition of resource limitations and natural functions of wetland and flood plain areas. The SENE Study has found all new development can be accommodated on C, F, and G lands (*as discussed in Chapter 3, Guiding Growth*), so that protecting A and B lands from inappropriate use need not be incompatible with a growing economy. In fact, a policy of resource protection and non-structural solution is regarded as a significant step toward protecting the physical beauty of the region's landscape which is expected to be in the long-term interest of the SENE region.

CHAPTER 9 LOCATING KEY FACILITIES

One of the most difficult issues to grapple with at the local level is the siting and operation of such key facilities as power plants, petroleum facilities, sand and gravel extraction operations, and solid waste disposal systems. This issue affecting planning areas throughout the SENE region, is discussed in *Chapter 9 of the Regional Report.* Sand and gravel extraction, although not a serious problem at present, may be more difficult in the future without proper planning for the use of mineral resources.

While other planning areas have more significant problems with key facilities than the Pawcatuck, special mention should be made of the controversial **New England Electric System proposal** to site a one billion dollar nuclear power plant complex at the former Charlestown Naval Air Station. The proposal to locate two to four 1200 megawatt nuclear units at the Naval Air Station has provoked negative reaction, not just from area environmentalists, but from the U. S. Department of Interior, which would like 367 of the site's 604 acres for a wildlife refuge. The site, the Charlestown Pond Complex, comprises 43 percent of the salt pond acreage of Rhode Island, 23 percent of its barrier beach acreage and 19 percent of its barrier beach shoreline.

Fortunately, some fairly detailed environmental site data has already been collected for the State of Rhode Island by the University of Rhode Island's Coastal Resources Center, under a New England Regional Commission Grant. The Study, "An Energy and Power Plant Siting Study for the State of Rhode Island" was not available to the SENE Study in its entirety. However, a summary report was released detailing specific siting considerations for the Charlestown site.

According to that report, the proposed Charlestown site and 32 others investigated all have "significant siting problems", ranging from the availability of land and fresh water, through possible damage to marine and land ecology, to conflict with other economic activities in the area of the proposed power plant.

With regard to the Charlestown site in particular, the report makes the following points:

(a) **Land Availability – Transmission.** A minimum of some 200 acres of new land will be required for transmission lines to the nearest grid point.

(b) **Water Availability.** There is insufficient fresh water for cooling purposes but sufficient amounts of salt water appear to be available in Block Island Sound.

(c) **Marine Ecology.** (1) Potential damage to the marshes, Ninigret Pond, and the barrier beach exists from the intake and outfall during construction and operation. (2) Run-off and sump-pump water could also damage the Pond.

(d) **Land Ecology.** (1) Potential damage to wetlands and marshes exists on the site, but depends on the location of plant and materials handling during construction. (2) Potential damage to wetlands, marshes, and the barrier beach exists from the intake and outfall construction and operation – particularly from delivery of reactor by barge.

(e) **General Site Considerations.** (1) Lack of adequate transportation facilities could be a problem during construction, especially in delivery of heavy components such as the reactor vessel. (2) A high water table and the uncertainty of bedrock geology could present problems during construction. (3) Problems may also arise in protecting the plant from a 1000-year-design storm. (4) Proper design including the use of tunneling and a submerged inlet and discharge would reduce the ecological problems involved with the cooling water intake-discharge systems. (5) The problem of site runoff can be controlled by diverting runoff water into a settling pond and treating it with poly-electrolytes to remove suspended solids. (6) Setting the plant and the staging areas as far inland as possible would protect the wetlands The higher the plant site the more protection there would be from the worst storm possible.

A more recent study by the University of Rhode Island Coastal Resources Center of the environmental impacts of the proposed complex prepared for the Governor confirmed these initial observations. But it also concluded that the power plant could be constructed and operated without causing serious damage to the Charlestown Pond complex and offshore waters, provided certain specific planning and engineering measures were instituted by the power company. Interior does not share this opinion; they do not agree that a nuclear complex represents the "highest and best use" of the site.

The initial interest by the Department of the Interior in converting the site to a wildlife refuge appears to have been modified in response to federal administration priority on re-use of surplus military land for energy-related purposes.

The General Services Administration (GSA), custodians of the 604-acre site, now proposes a "conditional sale" of all but about 50 acres to Narragansett Electric Company, an operating subsidiary of the New England Electric System. Interior charges that GSA is ignoring established and required procedures for disposal of surplus Government property.

If Interior decides that the national interest is served by a power plant at Charlestown and that this would be the "highest and best use of the land," and if the electric company rigorously adopts those measures outlined in the Coastal Resources Center's report and providing the site can be protected from storm damage and the barrier beach is maintained *(see Chapter 8)*, then the SENE Study sees no reason for opposing the development on the basis of *siting* considerations alone.

If the question of jurisdiction can be resolved, then the Study recommendation is:

1. **Continue planning the Charlestown nuclear power complex, applying environmental and safety criteria. Planning should proceed on the Charlestown nuclear power complex, providing the measures outlined by the Coastal Resources Center are met, the site can be protected from storm damage, and the safety questions now surrounding nuclear generation are resolved.**

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